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The history of forests and forestry in Wales up to the formation of the Forestry Commission

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The History of Forests and Forestry in Wales up
to the Formation of the Forestry Commission

by

William Linnard

Submitted for the degree of Philosophiae
Doctor of the University of Wales.

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Summary

An attempt is made to give, for the first time, a detailed account of the history of forests and forestry in Wales, from the last Ice Age up to the establishment of the Forestry Commission (1919). The account is based on palynological and archaeological evidence, classical literature, a wide range of manuscript and printed sources, place-name evidence, field studies and oral testimony.

Chapter 1 summarizes the available evidence for the development of the forests of Wales after the last Ice Age, and assesses the effect of man on the forests from Mesolithic times to the Iron Age.

Chapter 2 describes the man/forest relationships in Wales during the Roman period and the Dark Ages.

Chapter 3 describes the military significance of the Welsh forests during the period leading up to the Edwardian Conquest, and gives a detailed account of the forests and woodlands in medieval Wales, with particular reference to their multiple use. The monasteries were important influences in this period, and special attention is paid to the monastic woods.

Chapter 4 describes the deterioration of the forests of Wales from the 16th to the 18th century, and the influences on them during this period, with special reference to estate-building and the four major industrial forest products: charcoal, shiptimber, tanbark and pitwood.

Chapter 5 describes the general development of private estate forestry in Wales in the 18th and 19th centuries. This general picture is complemented by a detailed study of forestry on one Welsh estate for which unusually full records are available, viz. the Glamorgan portion of the Plymouth Estate. Finally, the measures taken to acquire statistical data on Welsh woods in the 19th century are outlined, and also the trends leading up to the formation of a national forest policy and the establishment of the Forestry Commission.

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Introduction

The history of forests and forestry in Wales has never been treated as a coherent subject, either by historians or by foresters. Economic historians have occasionally dealt briefly with the wood resources of a particular region or industry in Wales, or of a particular period of Welsh history, and foresters have occasionally treated some historical aspects of the forests of Wales and the practice of forestry. Even these unconnected studies are relatively few in number, and there is no substantial forest history of Wales, nor of England for that matter, on the lines of the authoritative forest histories prepared in recent years for Scotland¹ and Ireland², and much earlier for the continental countries regarded as the cradles of modern professional forestry, France³ and Germany⁴, and also smaller countries such as Belgium⁵. Even in countries where the history of forestry is not a long one, e.g. the USA, forest history is an accepted field of study and has already produced an important body of literature⁶. Under the initiative mainly of German forest historians, the history of forests and forestry is now also a recognized research field in the activities of the International Union of Forest Research Organizations (IUFRO).

In view of the foregoing, the absence of a forest history for Wales is all the more regrettable, because

forest was for a long time a widespread and important part of the vegetation of Wales, and forest products formed the vital raw materials for early industry and indeed for most classes of society until quite recent times.

The difficulties in compiling a forest history for Wales are manifold, in view of the length of the period to be considered, the paucity of documentary evidence for much of the period, and the absence of a solid corpus of published material directly relevant to the subject. Accordingly, a multi-disciplinary approach is required, drawing together pieces of evidence from such diverse fields as palynology and archaeology, linguistics and onomastics, records of private estates, parliamentary reports, historical documents, oral evidence, special forestry literature as well as general literature, and field studies. Among the many important original historical documents that have been calendared or published in full, material relevant to forests and forestry usually forms only an insignificant part. Among unpublished documentary material, comparatively few forest records have been preserved, even from the last century, and thorough searches of county archives and record offices indicate that estate forest accounts covering long periods are practically non-existent for Wales.

A further problem is the difficulty of using the conventional chronological divisions of history which, though essential as a framework, are not necessarily ideal for the treatment of forestry over a wide area and over a long period of time. Forests are long-lived and often self-perpetuating vegetation types, and forestry by its nature is generally a long-term form of land use but one employing diverse systems and with varying objectives. Traditional historical divisions do not correspond closely to the actual development of forests and forestry, and therefore, whatever divisions are selected, some overlap between periods is inevitable, and it is generally impossible to distinguish clear historical periods.

Accordingly, the research for this thesis was undertaken in the following way. A systematic survey was made of literature on the vegetation history of Wales since the last Ice Age, especially the palynological and archaeological literature. This was supplemented by careful study of the available documentary evidence relating to Wales from the earliest times to the start of the twentieth century. Where necessary, relevant evidence from outside Wales has been adduced to help to complete the historical picture.

Special attention has been paid to the evidence afforded by the major general surveys such as Domesday, the Norman surveys, the parochial enquiries of Edward Lhuyd, the reports

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to the Board of Agriculture, Parliamentary reports, Ordnance surveys, tithe surveys, etc., and also the accounts of percipient observers from the time of Giraldus Cambrensis to the fashionable English travellers of the nineteenth century. Other particularly important sources of evidence are provided by Cyfraith Hywel (the ancient Welsh Laws), monastic records, the estate surveys of the sixteenth and seventeenth centuries, and the forestry literature of the last two centuries.

In the final period, from the late eighteenth century onward, for which more evidence is available, a detailed study has been made on the forestry activity of one private estate in Wales to illustrate developments in some detail. Oral evidence and fieldwork have been used to substantiate and complement these studies.

The botanical nomenclature of tree species follows that given by A. Mitchell in A field guide to the trees of Britain and Northern Europe (Collins, 1974). Standard vernacular and/or botanical names have been inserted wherever possible to clarify the identity of unusual or obsolete names of trees. In certain specific cases, e.g. Table 40, original botanical nomenclature has been retained, without any attempt at 'correction' or 'modernization'.

Several different units and systems of weights and measures, many of them obsolete, are referred to in this thesis. Equivalent measures have been inserted wherever this was possible and was deemed useful to improve understanding (cf. R.E. Zupko, A dictionary of English weights and measures from Anglo-Saxon times to the nineteenth century, University of Wisconsin Press, 1968). However, as a matter of deliberate decision and in accordance with general practice in historical studies, no attempt has been made to give modern metric equivalents.

The spelling of Welsh place-names always presents difficulties, particularly in historical studies. In this thesis the orthography of Welsh place-names generally follows the forms given in Rhestr o enwau lleoedd:

A gazeteer of Welsh place-names (UWP, 1975), except in quotations and in cases where well-established English or anglicized names exist, e.g. Neath, Caerphilly. Medieval names follow the forms given in Welsh administrative and territorial units: medieval and modern (M. Richards, UWP, 1969). In certain specific cases, e.g. Table 35, original spellings of local place-names have been retained without any attempt at 'correction' or 'modernization'.

Forestry terms are used in accordance with the standard practice and recommendations of the English-language version of the Multilingual Forestry Terminology Series (Terminology of Forest Science, Technology, Practice

and Products, edited by F.C. Ford-Robertson, SAF, Washington, 1971). The meanings of obsolete and unusual English terms, and also of terms in Welsh and Latin are given in a Glossary of Special Terms (Appendix 1).

Acknowledgements

I am pleased to acknowledge the guidance and encouragement given to me during the preparation of this thesis by Professor Laurence Roche (my director of studies) and other members of the staff of the Department of Forestry and Wood Science at Bangor, and by Mr. Trefor M. Owen (Curator of the Welsh Folk Museum) and other colleagues at the Museum. Valuable advice was also given by Professor (Sir) Idris Foster (when Jesus Professor of Celtic at Oxford), Professor Dafydd Jenkins (Department of Law, Aberystwyth), the late Professor Emeritus William Rees, Professor Bedwyr Lewis Jones (Department of Welsh, Bangor), Dr. D. Huw Owen (Department of Welsh History, Cardiff), and Dr. Eustace W. Jones and other former colleagues of the Commonwealth Forestry Institute, Oxford.

Finally, my grateful thanks are due to my wife, Margaret, for typing the manuscript and for her unfailing encouragement.

CHAPTER I

FOREST DEVELOPMENT AFTER THE LAST ICE AGE,
AND HUMAN INFLUENCE ON THE FORESTS FROM
THE MESOLITHIC PERIOD TO THE IRON AGE

The salient features of the composition and extent of forests in the territory now known as Wales over the period since the last Ice Age have been fairly accurately determined by a large number of palynological studies, and also by analysis of specimens of charcoal and wood recovered during archaeological excavations.

The main application of pollen analyses has been to peat samples obtained from both upland and lowland bogs in various parts of Wales and also to buried soils associated with various archaeological sites. Some of the most important of these studies are given in Table 1 which, though it is not intended as an exhaustive listing, shows clearly that a good coverage of palynological evidence has been obtained and analysed for Wales since the pioneering work of the early 1930s.

The results of these pollen analyses may sometimes differ in local details, and in the later stages of the pollen record they often indicate divergent vegetation histories attributable in greater or lesser degree to the influence of man. However, taken together they reveal a great measure of agreement, and a quite consistent picture of vegetation development emerges which is confirmed by parallel studies carried out in England and in other parts of Northern Europe.

Table 1. List of Major Published Pollen Analyses for Welsh Sites.

Place	County	Author	Year	Source
Nant Ffrancon	Caerns.	L.M. Hodgson	1933	MA Thesis. Bangor
Pond Cairn	Glam.	H.A. Hyde	1938	<u>Archaeologia</u> 172-7
Tregaron Bog	Cards.	H.A. Hyde	1938	<u>New Phytol.</u> 44 ¹
Craig y Llyn	Glam.	H.A. Hyde	1940	<u>New Phytol.</u> 226-255
Figyn Blaen Brefi	Cards.	E.G. Davies	1944/5	<u>J. Ecol.</u> 147-155
Cwm Idwal	Caerns.	H. Godwin	1955	<u>Sv. Bot. Tidskr.</u> 56-43
Rhosgoch Common	Rads.	D.D. Bartley	1960	<u>New Phytol.</u> 238-252
Several sites	Glam., Brec.	C.B. Crampton	1963	<u>J. Ecol.</u> 453-459
Gower, Blaenau Morgannwg	Glam.	C.B. Crampton	1963	<u>BBCS</u> 326-337
Tregaron Bog	Cards.	J. Turner	1964	<u>New Phytol.</u> 73-80
Four sites	Brec., Glam. Rads.	C.B. Crampton	1964	<u>BBCS</u> 440-449
Llanllwch	Carms.	K.W. Thomas	1965	<u>New Phytol.</u> 101-107
Four sites	Glam.	C.B. Crampton	1966	<u>BBCS</u> 376-390
Mynydd Troed	Brec.	C.B. Crampton	1966	<u>BBCS</u> 71-77
Seven sites	W. central Wales	P.D. Moore	1969	<u>J. Ecol.</u> 361-379
Aberduhonw	Brec.	C.B. Crampton	1970	<u>Brycheiniog</u> 41-52
Carneddau Hengwm	Merion.	P.D. Moore	1973	<u>Nature</u> (5388) 350-3
Nine sites	Caerns., Cards., Brec. Carms., Glam.	H.J.B. Birks et al.	1975	<u>Proc. Roy. Soc.</u> B 87-105

The broad outline of forest development in relation to climatic phases and pollen zones, and also in relation to human economic activity and cultures is summarized diagrammatically in Fig. 1.

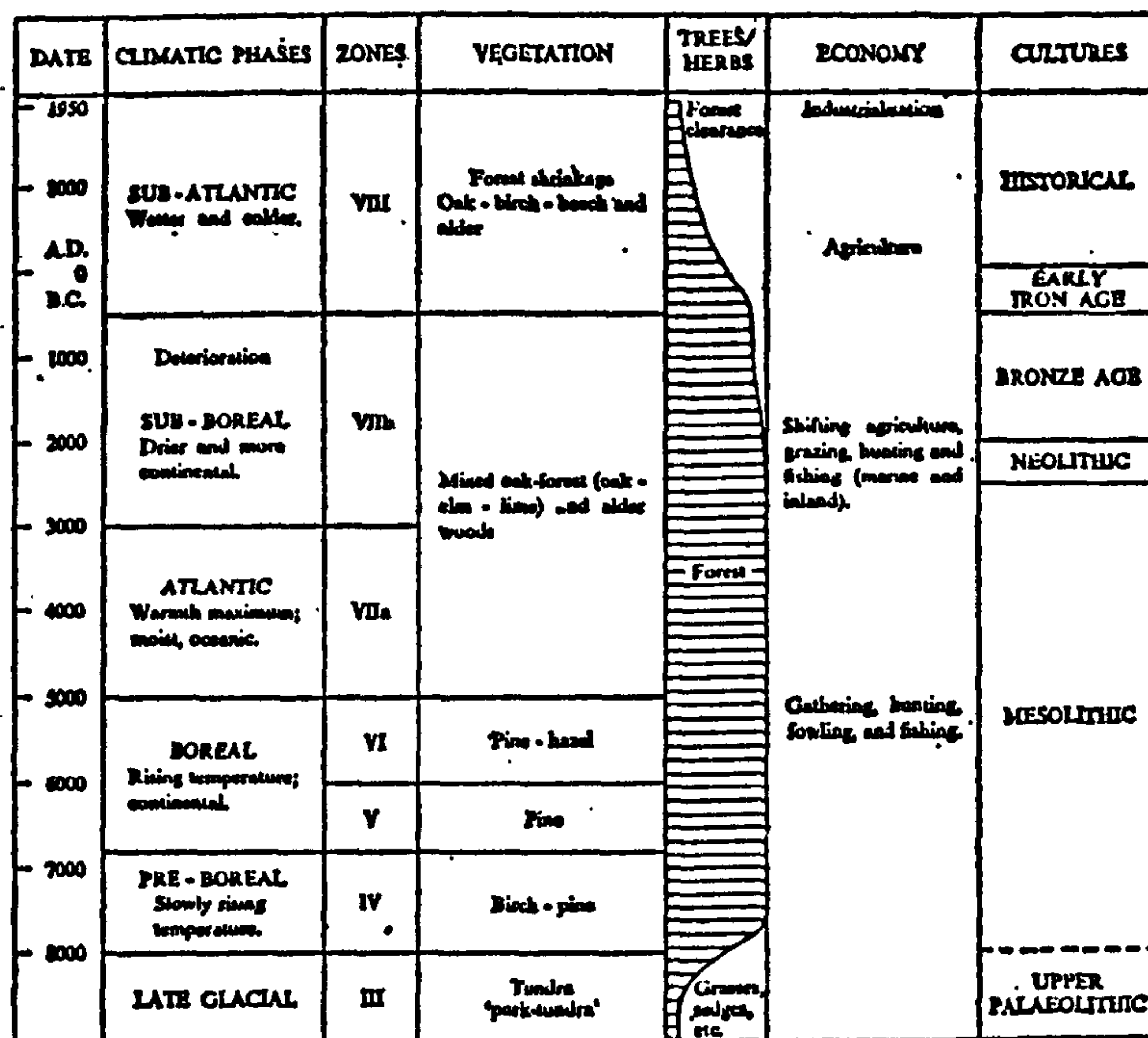


Fig. 1. Changes in climate, vegetation (especially forests), and human activity in Wales in the late-glacial and post-glacial periods. (After Hyde)⁷

In vegetational and climatic terms, Wales is placed in the Highland Zone of Britain. The picture of forest vegetation types given in Fig. 1 is very generalized and does not make any distinction between upland and lowland Wales. Subsequent studies have distinguished two areas within the Highland Zone, viz. Lowland (Atlantic) Wales and Upland (Highland) Wales, with vegetation exhibiting quite different patterns of development, which can be summarized in tabular form (Table 2).

Table 2. Vegetation Sequence of Highlands and Lowlands in southern Wales. (After Webley)⁸

Highlands	Historical periods	Climatic phases	Lowlands (Atlantic)
Grass and/or open mixed woodland	Modern	Sub-Atlantic	Grass
Heather + open mixed woodland	Medieval		Oak high forest + birch and hazel
Polypodium + open oakwoods	Iron Age		"
Oak high forest	Bronze Age	Sub-Boreal	"
Heather + open birch woods	Neolithic		"
Pine and alder	Iate Mesolithic	Atlantic	"

The Highland and Lowland zones may be compared with Fairbairn's refined climatic zonation of modern Wales, in which three climatic subzones are distinguished. These are obtained by superimposing on to rainfall zones the temperature zones adjusted to sea level and based on growing-season lengths. The three climatic subzones are Anglesey, Llŷn peninsula and the coastal strip of west and south Wales (G⁴c); the inland mountain massif (F⁴c); and the eastern border country (E³b).

Table 3. Climatic subzones in Wales (after Fairbairn).⁹

Climatic subzones	Growing season based on annual mean temperatures reduced to sea level	Annual rainfall in inches
G ⁴ c	> 280 days	> 40
F ⁴ c	260-280 days	> 40
E ³ b	240-260 days	30-40

During the Great Ice Age (Würm III, ca. 25,000-12,000 B.C.), ice covered the whole of Wales. Following the retreat of the ice, a sparse tundra or 'park-tundra' vegetation of herbs and subshrubs, including scrub willow, gradually developed. With slowly improving climate, the first tree species to colonize large areas was birch, a pioneer species capable of rapid spread and relatively undemanding as to site. The pollen records, e.g. from Craig y Llyn (Glamorgan), show that birch was for a time the sole tree species present. The next invading tree species was another light-demander, viz.

*Scots pine (Pinus sylvestris L.). Birch and pine continued to dominate the tree vegetation throughout the Pre-Boreal and early Boreal, apparently alternating in relative importance, e.g. in period V pine accounted for ca. 75% of the tree pollen at Craig y Llyn.

"Pine continued to be an important element of the vegetation throughout the Boreal period, birch declining somewhat in importance and other broadleaved species such as oak, elm and hazel becoming established. Hazel thickets appear to have occupied large areas, elm accounted for a small but steady proportion of the total tree pollen, and oak soon became of major importance. Alder (Alnus glutinosa) also appeared in the later Boreal. During the Boreal, a relatively warm and dry period, the overall forest picture seems to have been one of birch and pine covering all the Welsh uplands apart from the very highest mountains. Tree roots and wood are found in peat at altitudes of 1750 ft. and even higher, e.g. on Cader Idris,¹⁰ and even at 2000 ft. on the Gader in Breconshire,¹¹ but not generally above the 2000 ft. contour. Alder swamps occupied the valley bottoms, and mixed hardwood forests, with oak dominant, occupied the lower land and much of the hill slopes. During the Boreal, with rising sea levels and submergence of the land, Ireland became detached from the British Isles, and somewhat later the British Isles became detached from continental Europe.

The percentage of the land area of Wales potentially capable of carrying forest, i.e. below 2000 ft. (the present approximate upper limit of planting), is shown in the following table.

Table 4. The percentage of land lying within given contour belts (adapted from Ashby & Evans)!2

County	0-1000 ft.	1000-1500 ft.	1500-2000	Over 2000 ft
Anglesey	100	-	-	-
Brecon	42.7	39.3	15.2	2.8
Caernarfon	71.4	16.1	7.8	4.7
Cardigan	75.5	17.8	6.4	0.3
Carmarthen	89.9	8.7	1.3	0.1
Denbigh	64.5	30.4	4.5	0.6
Flint	96.3	3.6	0.1	-
Glamorgan	85.9	11.7	2.4	-
Merioneth	52.6	30.6	14.2	2.6
Monmouth	84.0	12.7	3.3	-
Montgomery	63.4	28.0	8.3	0.3
Pembroke	98.3	1.6	0.1	-
Radnor	44.9	45.6	9.2	0.3
Wales	73.0	20.0	6.0	1.0

The table shows that of the land area of Wales only 1% (= 47,885 acres) lies above 2000 ft., i.e. above the probable upper forest limit, and 93% (= 4,765,789 acres) lies below 1500 ft. Some 6% (= 309,576 acres) of the land area lies between 1500 and 2000 ft., i.e. at altitudes where tree growth was still possible, though growth rates would not have been fast.

Fig. 2 shows the area of land at altitudes below 2000 ft., i.e. the area of land potentially capable of carrying trees, and thus the probable maximum extent of tree cover in Wales at the climatic optimum. Naturally, areas of sand, lakes, rock and special sites such as salt marsh or very exposed areas would not have carried forest vegetation.

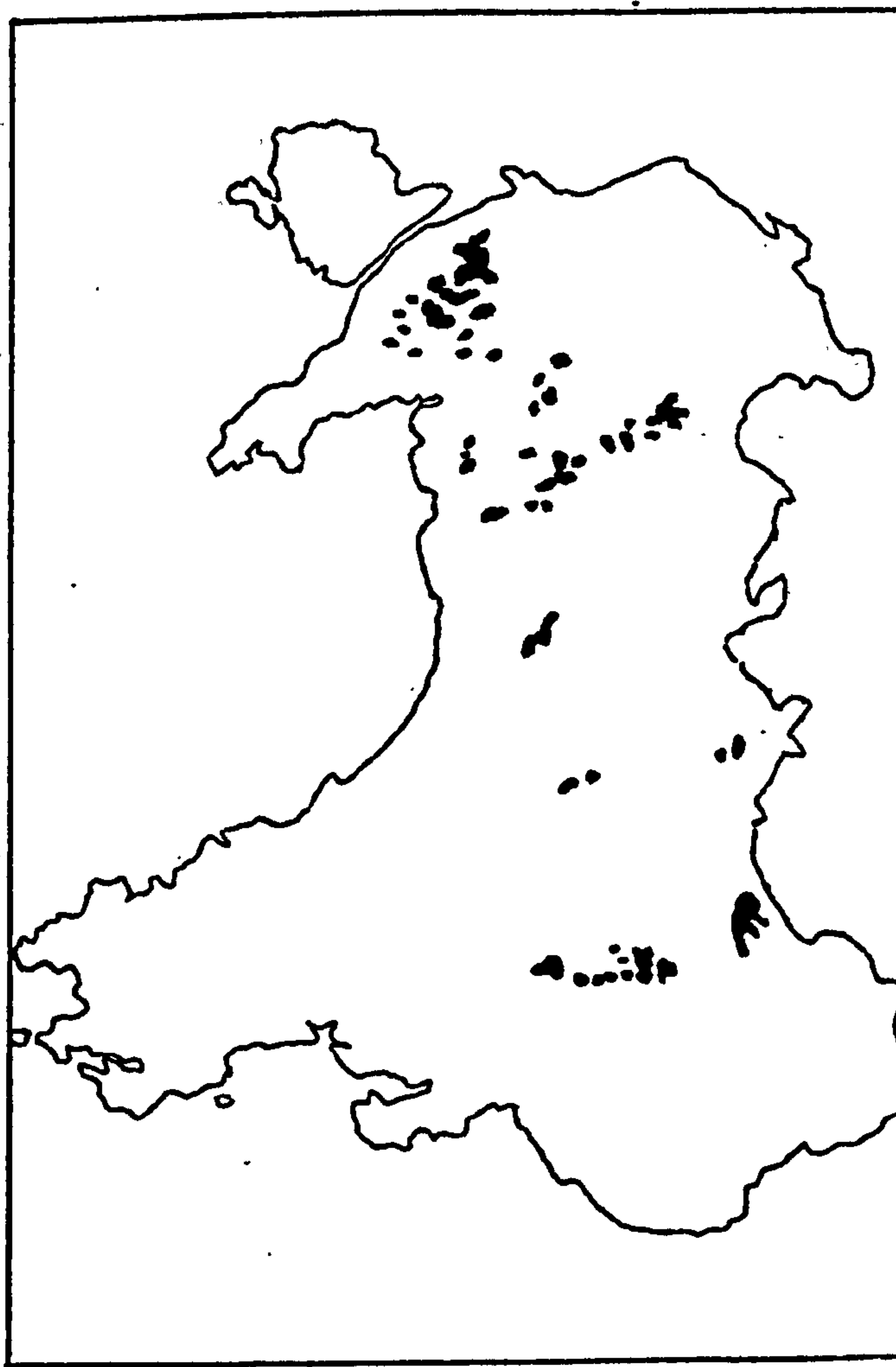


Fig. 2. Land above 2000 ft. in Wales (coloured black).

After the Boreal, the climate became wetter during the Atlantic period, with a warmth maximum. The proportion of alder increased substantially and that of pine decreased sharply to a very low but fairly steady level. During the Atlantic climatic optimum, lime (Tilia cordata) immigrated and formed a small but important element of the mixed oak forests (oak/elm/lime), especially on lower and warmer sites. Oak forests became the characteristic and major vegetation of the lowlands in the Atlantic and later periods, and of the highland zone too in the later Sub-Boreal period. Tycanol Wood (Pembrokeshire, SN 092368) is an area of primary sessile

oak/ash/hazel where there has almost certainly been some woodland cover since Atlantic times, as evidenced by the bryophyte flora. Over 100 species have been recorded, including many old forest indicator species. Only a few other woodlands with over 100 epiphytic lichen taxa are known in Wales, viz. Gwaun valley (N. Pembrokeshire), Coedmor (Cardiganshire), Dynevor Park woods (Carmarthenshire), Coed Crafnant (Merioneth), and Gregynog Great Wood. (Montgomeryshire).¹³

During the Atlantic period, peat mosses gradually invaded the upper slopes and plateaux. The effect of the small Mesolithic population of food-gatherers, hunters and fishers on the vegetation in this period has hitherto been generally thought to be slight, but recent research suggests that human influence may have been more important and, in conjunction with climatic change, could have brought about significant modification of forests. The ability of small numbers of men with hand-axes and the deliberate use of fire to modify or destroy forest communities can be considerable. As Smith puts it:

'At the moment it is virtually impossible to decide whether man was responsible for any general vegetational changes, but the possibility appears rather strong that human activities did have an effect in particular cases ... There is fairly clear evidence of human influence on vegetation from early in the Atlantic period onwards. The actual date of these activities requires further elucidation, as does the scale of the effects. The impression is given from the magnitude of the changes in the pollen curves, however,

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that man's activities affected the vegetation well outside the immediate vicinity of his living-places, and the possibility cannot be rejected that the Atlantic vegetation of the British Isles was at times composed in part of secondary communities.¹⁴

Isopollen maps of Pinus, Betula, Quercus, Ulmus, Alnus, Corylus and Tilia for 5000 B.P., i.e. just before the start of marked decline in Ulmus pollen and before the start of significant forest clearance by Neolithic man, have been prepared from studies at 9 sites in Wales.¹⁵ The findings suggest that pine was not a prominent component of the forests of Wales; birch was not a major forest tree though occasional high pollen values are recorded in south Wales; oak was the major component of the forests; elm gave moderately high percentages in parts of south Wales but very low values in north Wales; alder showed high pollen frequencies in north, mid and south Wales (but not in south-west Wales); hazel exhibited high values everywhere except Snowdonia; and lime was important in mid Wales. The date of entry of ash (Fraxinus excelsior L.) is uncertain, but charcoal has been found in at least 11 sites, dated as Neolithic or later, and small amounts of ash pollen are present in the Sub-Boreal.¹⁶ Yew has been present in southern Britain at least since Neolithic times,¹⁷ and holly is recorded in south Wales in the late Boreal.¹⁸

The relatively dry Sub-Boreal period (VII b) was followed by a period of climatic deterioration in the Sub-Atlantic (VIII) with cooler and damper climate, which saw the spread of wet

moorland grasses, sedges and bog-mosses, and a decline of forest, accompanied by increasing influence of technologically more advanced peoples of the Neolithic and Bronze Age cultures.

Stone axe factories have been found in several places in Wales.¹⁹ The Mesolithic chipping-floor in the (modern) Rhondda forest, Glamorgan, yielded a few hand axes.²⁰ Neolithic axe factories have been found at Graig Lwyd (Penmaen-mawr) and Mynydd Rhiw, in north Wales, and others at Preseli, Ramsey and St. David's Head in south-west Wales.²¹ The Mynydd Rhiw axe factory produced tree-felling axes for Neolithic agriculturists. The few Mynydd Rhiw axes identified so far in Wales and the Marches are all of the heavier, i.e. tree-felling, type.²²

The Neolithic colonists entered Wales via western sea routes and also from the east, practising shifting cultivation and livestock husbandry. They probably followed lines of least resistance, i.e. where the forests that still covered most of the land surface were most amenable to clearance, viz. the open upland woodlands of oak and/or birch type at around the 1000 ft. contour, and the exposed coastal districts in the west. Crampton and Webley have shown that the Neolithic colonization of Breconshire in the Sub-Boreal occupied an area of stunted heathy scrub forest of birch and sessile oak, not the damp oakwood type with dense underwood.²³ The picture is similar in Arllechwedd Isaf, in the lower Conway valley.²⁴ Everywhere the advent of the Neolithic farmers was accompanied by a sharp drop in the percentage of elm pollen. The elm decline is now generally ascribed to the selective influence

of man, in felling or lopping trees particularly suitable for leaf-fodder for pounded livestock. Lime too, and perhaps also ash, is believed to have been affected in the same way, though the only positive recorded evidence for this practice of feeding livestock on tree foliage at any period in Welsh history refers to oak (see p.95).

Clearance of natural woodland, presumably by shifting cultivation (slash-and-burn agriculture), by Neolithic farmers has been proved by pollen analyses. The main features of the actual procedures can be deduced from the techniques of shifting cultivation practised in parts of Northern and Eastern Europe until comparatively recently, and amply recorded by competent observers.²⁵ Initial site selection was a skilled job, to avoid frost hollows, areas prone to waterlogging, and stoney terrain. Open woodland rather than dense hardwood forest would obviously be preferred. Trees were dealt with in two ways - large trees were killed by girdling the bark and chopping away some of the sapwood; smaller trees were felled. Stumps would probably be left in situ, as uprooting for only short-term agricultural utilization would be excessively laborious. The felled material would be spread over the area and left to dry out, perhaps for as long as a year. Burning would be done in one operation, probably in spring, and perhaps repeated if necessary. Crops would often be sown under dead standing trees, sometimes straight into the warm ash. If tillage was necessary, a hoe, mattock or digging stick would be used. Bigger unburned material would be formed into a protective

fence or 'windrow' around the area to keep out unwanted animals such as deer and bears. Modern experimental clearance work, reviewed by Coles,²⁶ confirms these observations.

The main areas of Neolithic settlement in Wales were in Anglesey, Llŷn, Pembrokeshire, the Ardudwy foothills, the upper Dee valley, and the Black Mountains of Breconshire.²⁷ Colonization was at medium altitudes, below the levels of their Mesolithic predecessors. In the mixed arable and livestock husbandry of the Neolithic farmers, sheep were an ideal means of exploiting open oakwoods and would have had a significant effect in eliminating regeneration around settlements. Webley summarizes evidence to prove that in Wales, and other parts of western Britain, sheep were the main livestock of the Neolithic farmers, and he postulates a semi-parasitic relationship (natural commensalism) between sheep and man in this period.²⁸

Each slash-and-burn site would be cropped for only a few years, before its fertility was exhausted and another site would have to be used. This would in fact result in a regular programme of tree girdling and felling, drying out and burning, and then cultivation. Felling operations would have to be done a year or more before crop sowing took place. Some of the coppice regeneration from stumps in and around the cleared areas would be destroyed by grazing animals; surviving sprouts from successive clearings would tend to form an age-sequence. Recent excavations in the Somerset Levels have revealed numerous wooden trackways of Neolithic age and of various types, viz. worked planks, bundled brushwood and 'corduroy' logs, and large hazel

hurdles. Some of the trackways indicate sophisticated methods of production and utilization of woody species. It is concluded that there is ample evidence for coppiced hazel stands in the Somerset Levels from the fourth millennium B.C. onwards, and this together with other evidence is taken as indicating 'well-organized forest management for at least four thousand years'.²⁹ No such evidence has been discovered in Wales, but it seems that the observation of coppicing and its systematic application for the production of desired assortments may have been a regular form of woodland management since Neolithic times in Wales.

In its effect on the forests, the Bronze Age can probably be considered as an extension and intensification of a basically Neolithic way of life³⁰, viz. shifting cultivation, coupled with stock-raising, carried out at first in upland oak high forest areas, but later in the Sub-Boreal, with climatic deterioration, in oak high forest areas at lower altitudes. Crampton has shown that podzolization probably began under Bronze Age oak forest³¹. Excavations at Pond Cairn (Glamorgan)³² revealed charcoal of gorse, hawthorn and bracken, as well as hazel, indicating that forest clearance had been considerable, and that secondary scrub had invaded abandoned fields and pastures. Indeed, Godwin points out that scrub was almost unknown before Neolithic times, but increased from the Neolithic period onward. The percentages of Prunus, Sorbus, Crataegus, Sambucus, Malus, Pyrus, Rosa, Rhamnus and Ulex all increased substantially at the onset of prehistoric agriculture.³³

The early Iron Age saw the advent of improved technology and a more settled mode of life, as witnessed by the many hundreds of hill forts and settlements in all parts of Wales and the Marches³⁴. These forts were generally at lower altitudes than the areas colonized by the Neolithic peoples, often at about 600 ft., and mark the start of major clearance of the dense low-altitude forests in Wales. Dwellings within the forts were circular, with a ring of wooden posts supporting the roof, or a single central post, or even of wigwam type. Wood utilization for building and for fuel at permanent and often large settlements would probably have involved the development of areas of coppiced woodland around the settlement. Iron axes were much more efficient than stone axes for tree felling. Wood was also used to make the charcoal for smelting the ore to produce the iron tools.

As summarized by Cunliffe, the settlement pattern and economy in south and west Wales appear to have been mainly characterized by individually defended homesteads, with cattle-rearing important, sheep probably more important in the more mountainous regions, and with limited cereal cultivation. In north Wales, settlement was characterized by large hill-top settlements, with sheep probably more important than cattle, and grain also important. Along the Welsh Borders, mixed farming with cereals, sheep, cattle and pig appears to have predominated in the south, whereas pastoral activities took precedence over cultivation in the north.³⁵

This period also saw the immigration of the last tree species into Wales to form part of the native flora before the period of

introduction by man, viz. beech (Fagus sylvatica L.) and probably hornbeam (Carpinus betulus L.). Beech is native in Wales only in the south-eastern corner, i.e. in Monmouthshire, south-east Breconshire and east Glamorgan, where numerous relict beech woods and place-names incorporating the Welsh name for beech are found within or immediately outside the eastern fringe of the coalfield³⁶. The pollen evidence for the presence of beech in Wales before the Roman invasion is not conclusive, but the discovery of quantities of beech charcoal in an Iron Age hearth at Radyr (Glamorgan) dated at or before the first century A.D. proves the nativity of beech in Wales³⁷. The charcoal in this hearth was in the form of short thick sticks, 1 inch in diameter and $\frac{1}{2}$ to 2 inches long, some evidently cut with an axe. Of the 90 pieces identified at least to generic level, the species represented were as follows:

Ash	20	Hawthorn	5
Oak	16	Willow	5
Hazel	14	Birch	4
Beech	12	Maple	2
Elm	7	Holly	1
Alder	5		

The forest environment at Radyr was presumably ash/oak/beechn woodland, with elm (probably Ulmus glabra) an important accessory species, and also occasional birch, maple (Acer campestre) and holly, with hazel the main shrub. Apart from birch, all the species listed still occur in the present-day woodlands at the hearth site, together with sycamore and lime.

Early references to beech as a timber species in south-eastern Wales include the ancient Welsh Laws, where ffawydden (= fagus in the Latin versions of the Laws) is usually valued at 60 pence, i.e. half the value of an oak, but occasionally at 120 pence, i.e. equal to oak (cf. pp. 49-50)³⁸. In Monmouthshire, beech trees (fagis) were used in 1286-7 to repair Llangibby Castle,³⁹ and a beechwood called Payneswode was recorded in the lordship of Tregrug in 1314.⁴⁰ Numerous place-names incorporating elements of the Welsh name for beech (ffawydd, -en, -og) have been recorded in the counties of Brecon, Monmouth and Glamorgan from the 14th century onward, and mapped to show the distribution of the species.⁴¹

Hornbeam came into the same general area of south-east Wales as beech, along with it or very soon afterwards.⁴²

The evidence for the native status of beech is indisputable. The whole question of the post-Boreal status of Scots pine (Pinus sylvestris L.) in Wales is much more doubtful, but may be considered here. Pollen records from north and south Wales, e.g. Nant Ffrancon and Craig y Llyn, show pine present at all levels from the Pre-Boreal onwards, but from the end of the Atlantic period (ca. 3000 B.C.) at levels so low that the pollen may have been carried in by wind from sites far away, e.g. in Ireland. At Nant Ffrancon 'there is substantial evidence that at no period was the valley entirely devoid of an occasional pine, probably up to the present day'⁴³. Hyde concludes that pine died out 'almost if not quite completely ... in Wales'⁴⁴. Remains of pine trees in submerged forests off the coast between Penmaenmawr and Priestholm were recorded by

John Ray⁴⁵ in 1662, and pines have also been identified off the Cardiganshire coast at Borth and Ynyslas⁴⁶. Godwin concluded that 'it is possible that a relict stock of native pine has persisted [in Wales] in special bog and mountain sites'⁴⁷. For example, a belt of pine growing adjacent to Borth Bog may possibly be lineal descendants of the pine trees found in the submerged forest.

Pine charcoal was found in a Neolithic cairn at Bryn Celli Ddu (Anglesey) dated at ca. 1500 B.C.⁴⁸ Pine trunks and stumps have frequently been reported from peat beds in various parts of Wales, e.g. at Llyn Llwydiart in the parish of Pentraeth (Anglesey)⁴⁹, in Cwm Bychan (Merioneth)⁵⁰, 'in the deeps of Monmouth, where turfe is digged, also in Wales, Aburgauennie, and Merioneth, in sundrie parts of Lancashire, where great store of firre hath growen in times past'⁵¹, and in north Wales where 'many bodyes of Firr trees are found buried in the earth in boggy moorish places'.⁵²

Significantly, the earliest literary reference to pine in Welsh (lluch bin = flaming pine, i.e. burning torches or fires of pine) comes not from Wales itself but from the country of Gododdin, between the Forth and the Tyne, in a poem by Aneirin in the 6th century⁵³. Other early literary references to pine in Welsh (ffenitwydd, ffenytt, ffinydwydd) occur in manuscripts of the 13th century, viz. Cad Godeu and Mabinogion (White and Red Books). Although the original sources of the surviving manuscripts are from even earlier periods, they cannot be regarded as providing definite evidence

of the existence of living pine in Wales. The same applies to later poetical references to pine, e.g. by Madog Benfras in the 14th century.⁵⁴ Place-name evidence is even more uncertain. There appear to be no early place names that incorporate a pine/fir element, though it has been suggested that names such as Coed Du or Coed Duon (= black wood) may refer to former pine-dominated woodland. The name Rhiwbeina (near Cardiff), which is recorded in various spellings since the mid 17th century, has been interpreted as 'rhiw'r pinau' (= hill of the pines)⁵⁵. However, the earliest version of the name appears to be Riu-Brein (Book of Llan Dâv, mid 12th century), and the linguistic evidence is therefore extremely doubtful. Scots pine was planted widely in Wales at least from the middle of the 17th century onward (cf. p.144), but there is no positive evidence of the existence of living Pinus sylvestris in Wales before then. Therefore, the possibility of the uninterrupted survival of the species in Wales since Boreal times must remain open and doubtful.

The picture of the forests of Wales at the start of the Roman invasion in the first century A.D. may be summarized in general terms as follows. Areas of settlement and cleared agricultural land existed in a matrix of mainly oak forests extending up to altitudes of ca. 1250 ft., or higher in sheltered valleys. The native oakwoods were of two main types, viz. pedunculate oak forest (dominated by Quercus robur) in the lowlands, with associate species including wych elm, lime, maple, cherry, aspen, holly and yew, and often hazel underwood; and sessile oakwood (dominated by Quercus petraea)

forming the typical native woodland over the large part of upland Wales, with older acidic rocks and higher rainfall. Birch and bracken were the typical associates, and birch would have formed pure stands in places, especially at higher altitudes.

On particular sites, other forest types would have predominated, viz. alder woods (Alnus glutinosa) with willows on marshy valley-bottom sites; beechwoods (dominated by Fagus sylvatica) and with some oak and elm in restricted areas on limestone and old red sandstone in south-east Wales; and ashwoods (dominated by Fraxinus excelsior) and ash/oak mainly on steep slopes on carboniferous limestone in south Wales.

The pattern of land use around settlements consisted of temporary or semi-permanent clearings for agriculture, areas of grazed forests or open woodlands, with occasional selective fellings and perhaps regularly coppiced woods. Away from areas of settlement, the structure of the primeval forests, unmodified by man's activity, is generally assumed to have consisted of a relatively high proportion of very old and large trees with little underwood and large quantities of rotten stems and other fallen debris on the ground.

CHAPTER II

FORESTS IN WALES IN THE ROMAN PERIOD AND THE DARK AGES TO DOMESDAY

1. Forests in Roman Wales
 2. Forests in Dark Age Wales to Domesday
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1. Forests in Roman Wales

The conquest and subsequent partial settlement of Wales by the Romans brought profound changes to the country and the people, and these changes extended to the forests, where certain important modifications were initiated, notably in management, utilization, tools, and the introduction of exotics. Roman documentary sources give only tantalisingly brief references to Wales, but archaeology is still adding rapidly and substantially to the picture of Roman Wales, modifying the earlier idea of a primarily military presence and indicating more and more a settled and civilian influence.

The main outlines of the conquest and occupation have been described in some detail, e.g. by Richmond⁵⁶ and Frere.⁵⁷ Little direct information is available on the forests of Wales, however, or on the practice of forestry in the country during the Roman period. Still, much may be inferred from accounts of military campaigns, reports of archaeological excavations, and analogies with data from other parts of the Roman empire.

In view of the species composition of the forests given in the previous chapter, Caesar's reference to the absence of fagus and abies in south-east England (praeter fagum et abietem)⁵⁸ during his expeditions in BC 55 and 54 has caused dispute and confusion. The statement is explained by Loudon,⁵⁹ who considers that fagus was probably used to mean sweet chestnut but that if the term fagus was used in the sense of beech proper, the explanation would be that beech was not then common in SE England. Caesar's other description of the woods is unambiguous: 'A town among the

Britons is nothing more than a thick wood, fortified with a ditch and rampart, to serve as a place of retreat against the incursions of their enemies'.⁶⁰ Tacitus describes the piecemeal conquest of the tribes in Wales over a period of some thirty years, starting soon after AD 43 and ending with the final crushing defeat of the Ordovices in North Wales in AD 78. There is no doubt that the Welsh tribes, for the most part bitterly hostile to the Roman invaders, used their native forests as places of refuge and as places of ambush. For the Romans, the military conquest was partly a war of attrition and partly of gradual encroachment, until the tribe concerned was forced into the final pitched battle in which Roman organization and arms prevailed. The Silures of south-east Wales, 'altered by neither cruelty nor mercy',⁶¹ opposed the Romans fiercely, probably from their base in Llanmelin wood a few miles east of Caerleon,⁶² and were not finally subdued until AD 74 by Frontinus. The Ordovices in north Wales were finally beaten and massacred at the hands of Agricola in AD 78.

The Roman attack on Anglesey in AD 60 commenced the destruction of Druidical power on the island. One of the first actions by the victorious Roman governor, Suetonius Paulinus, was to fell the Druidical groves: 'the groves dedicated to sanguinary superstitions were destroyed'.⁶³ It is probable, though not certain, that druidism represented a forest cult. The origin of the word Druid is obscure, though the popular etymology from *Druid* (oak) is probable. Pliny the Elder said of the druids that 'they hold nothing more sacred than the mistletoe and the tree on which it grows provided that it is a robur. They choose

the robur to form oak groves, and they do not perform any religious rites without its foliage ... Anything growing on those trees they regard as sent from heaven and a sign that this tree has been chosen by god himself. It [the mistletoe] is however very rarely found [on the oak], and when found, it is gathered with great ceremony'.⁶⁴ It is uncertain how much credence should be given to this, or how far the forest is an original feature to the background of druidism.⁶⁵ In any case, organized and systematic destruction of the oak groves on Anglesey was one of the first priorities of the Roman invaders.

The military problems of advance against hostile tribes in rugged and well wooded terrain in Wales must have been similar to those described by Tacitus in the Roman campaigns in Scotland: 'When we used to plunge into the woods and thickets, all the brave beasts [i.e. the hostile tribesmen] charged straight at us', but after a battle, when the enemy 'reached the woods they rallied and profited by their local knowledge to ambush the first rash pursuers'.⁶⁶

The Roman military campaigns required timber. Wood was needed, e.g. for the flat-bottomed landing craft hurriedly built for the assault on Anglesey, and for the defences and structures of the original Roman camps and forts. The Romans carried essential supplies, including timber assortments, with them from base, but local timber would have been cut and used wherever possible. The network of Roman military roads involved considerable forest clearances, not only for the actual roadways themselves, but presumably also for some distance on either side, in order to reduce the possibility of ambush or sniping.

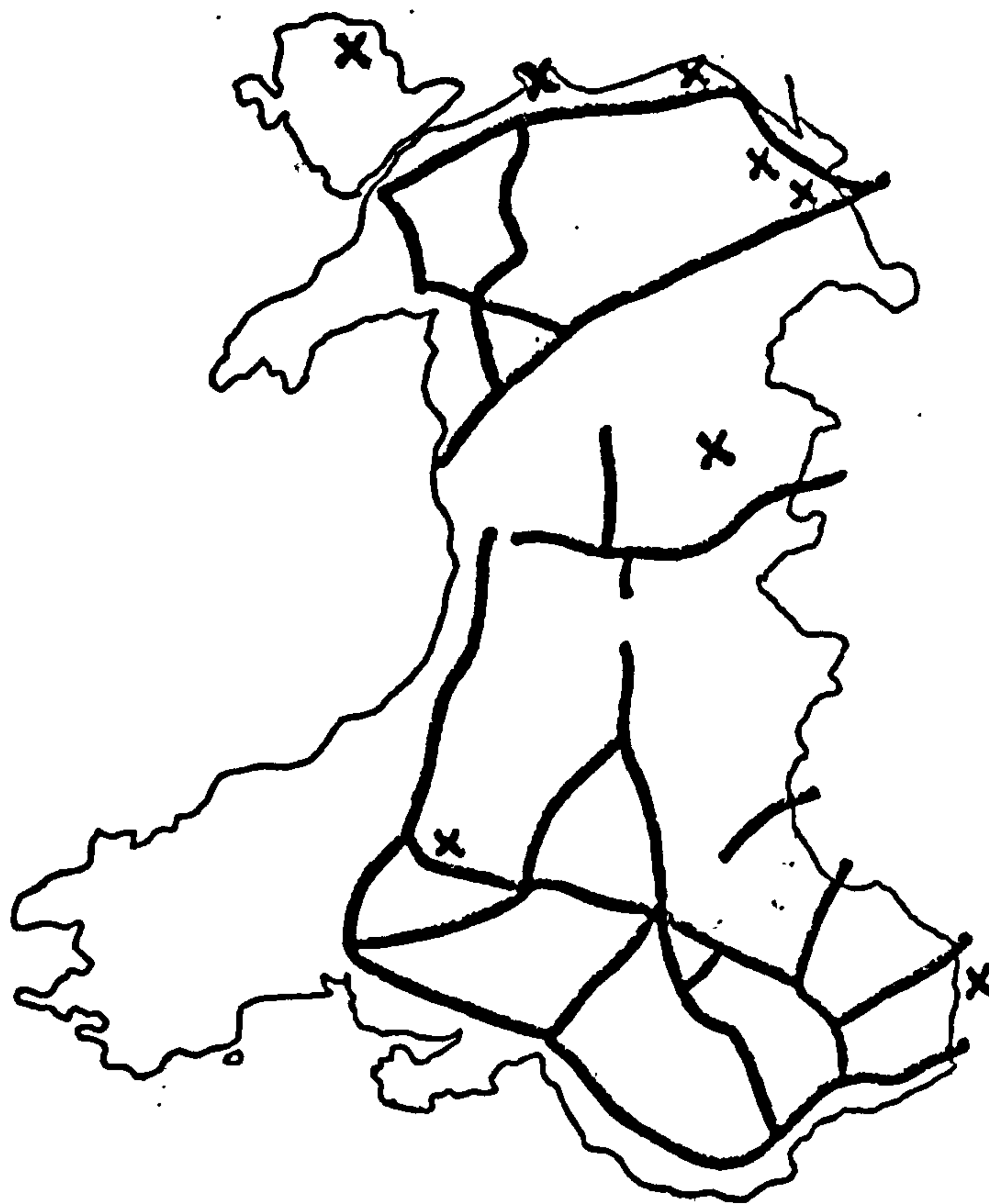


Fig. 3. Map of Roman Wales, showing the main road network and mining sites (after Richmond⁶⁷).

Frere concludes that one of the chief contributions of Rome in Britain was that 'she broke through the successive belts of forests with her new main roads, and for the first time knit together the various habitable belts in one unified transport network'.⁶⁸ In other words, the Roman roads represented the first stage in the systematic break-up of the great Welsh forest tract into smaller units.

Excavations of the Roman forts in Wales have shown that large amounts of wood were used in their construction, and that extensive fellings of the native forest in the locality

supplied most if not all of the requirements. At the Gaer at Coelbren (Glamorgan) for example,⁶⁹ large numbers of logs were used in the rampart foundations. These logs were mainly oak, unbarked, 17 ft. long and 8-9 inches in diameter, with the marks of the axe-cuts still visible. Some logs were split lengthways. Above these logs was a layer of earth, topped by small logs and branches, mainly birch. In some places, boards up to 1 ft. 3 in. wide were used in the ramparts and as pavements. This indicates oak and birch forest in the vicinity of the camp, at about 800 ft. altitude; utilization was mainly of small trees in the form of roundwood, but conversion capability for dealing with larger trees was evidently available. At Segontium (Caernarfon) the first Roman fort, built ca. AD 75, was of timber.⁷⁰ The stone fort was built later, in the second century AD. Excavations have revealed oak-lined wells and pits, wooden booths and hutments, postholes for gateways prepared for timbers nearly a foot square, and other postholes for buildings, generally 3-5 inches square, but sometimes round. At High Pennard promontory fort (Gower, Glamorgan) the timber for the fort was felled in the local limestone woodlands of oak, elm, ash and hazel.⁷¹

Similar evidence can be adduced for many other forts, large and small, and indicates an organized timber industry, with a wide range of skill in carpentry for timber-framed building, employing both roundwood and squared timber from local resources, chiefly oak. As summarized by Richmond, the situation was that 'the need for seasoned timber; its preparation in quantity against engineering tasks; its transport, erection, dismantling and return to stock; all imply a degree

of organization and preparation of materials which lay at the root of the efficiency of the Roman Army'.⁷²

In their own homeland, the Romans had a highly developed forest administration, and system of forest legislation. This has been described in detail by Béranger.⁷³ It is certain that this system of forest administration and legislation must have extended to parts of the Roman Empire, though no evidence is available to indicate the actual details or extent in Wales. In France in the Gallo-Roman period two major forest systems were distinguished, viz. silvae matriariae (high forest) and silvae caeduae (coppice); forests were also distinguished according to utilization, viz. silvae glandiferae where pannage was the most important, and silvae vulgares where wood was the most important product.⁷⁴ Forests were also distinguished by means of regeneration, viz. silva regerminans (regenerating by seed), silva repullulans (regenerating by coppice sprouts), and silva stolones radicibus emittens (regenerating by suckers).⁷⁵

Economic exploitation and development followed closely on the military conquest. The Romans frequently annexed the estates of their conquered enemies, and worked the forests for timber, charcoal and other forest products. In Wales, the value of metalliferous ores - gold, copper, lead, silver and iron - was swiftly realized by the Romans, and the development of mining and smelting involved the consumption of considerable amounts of wood in the mines and also for the manufacture of charcoal. Civilian settlement in Romano-British towns and villas also seems to have been more important

in the rural development of Wales than was believed until recently, and this too would have had implications for the forests.

In every province of the Roman Empire there were state domains, and in the provinces administered by the emperor's personal nominees these were the emperor's personal estates, consisting of lands, forests, mines and other economic enterprises.⁷⁶ In nearly all cases, the original nucleus of such properties was formed by the crown-domains of previous rulers, often enlarged by bequest, confiscation and escheatment. The domains often also included the lands of those who had actively resisted annexation.

The improvements by the Romans in the rural development of Britain included a number of introductions of important tree species. The Romans introduced the cultivated cherry, medlar, mulberry, fig, walnut, and sweet chestnut (Castanea sativa L.) and possibly also the horse chestnut (Aesculus hippocastanum L.), holm oak (Quercus ilex L.) and perhaps sycamore (Acer pseudoplatanus L.). The date of introduction of sycamore remains uncertain,^{*} and sycamore is regarded by some authors as a probable Roman introduction,⁷⁷ but by others as an early medieval introduction into Britain.⁷⁸

Analysis of Roman villa sites in relation to soil types indicates the integral part played by woodland for pig-rearing and general livestock grazing in the Romano-British farming system, and at the Roman farm at Langton (York) a windbreak of sycamore, walnut, sweet chestnut and native tree species was apparently established.⁷⁹

^{*}For discussion of the history of sycamore in Britain, see E.W. Jones. J. Ecol. 1944 32 235-7.

In their utilization of the forest resources of Wales, the Romans had the advantage of superior technology. Reciprocating saws (serrated flint saws) had existed since at least the Neolithic period, and were copied in copper and bronze in the Bronze Age. Various iron hand saws were manufactured in the Iron Age, but the Romans developed tooth setting and frame-saws, used long two-handled saws for the conversion of felled timber, and first developed mechanization of reciprocating saws.⁸⁰ In addition to saws, the range of Roman forestry implements included the basic securis, i.e. the woodman's axe, with convex cutting edge, the sides of the blade more or less concave in profile, and with the blade wedge-shaped in section. Secures varied considerably in size, weight and shape, the woodman's axe being wider and more convex than the axes used by the carpenter or butcher. Heavy long-handled axes were used for felling, and lighter short-handled types for splitting logs, chopping out roots, making stakes, etc. The double-bladed type (securis dolabrata) had a vertical cutting edge on one arm and a horizontal one on the other; it closely resembled the mattock, and was ideal for tree felling and the chopping out of roots in land clearance operations. The shape and method of axe hafting have remained largely unaltered to the present day. The dolabra (hatchet) was a double-headed tool with a narrow axe-blade on one side and a straight or curved pick on the other. The dolabra was used for grubbing out stumps and roots, and also for splitting and shaping logs. The type with the upward-curving pick was apparently used for rolling logs into position, i.e. it served as a cant-hook or peavey. Other forest tools were the dolabella (a small short-handled hatchet), the serrula (a small saw, often

a pruning saw), and the falx arboraria (the common billhook with a curved blade, used for lopping trees). Other forms of falx (pl. falces) were the falx lumaria (a thorn cutter or slasher), falx putatoria (a tree-pruning billhook), and various tools for cutting bracken, brambles, etc.⁸¹ It is likely that one of the main uses of the billhooks and slashers was for lopping branches of selected broadleaved tree species to provide winter cattle feed.

The population of Roman Wales is very tentatively put at about 50,000, and labour-intensive mining of gold, silver, copper, lead and iron must have represented major industries. Mining rights were normally an imperial monopoly leased out to contractors by a procurator metallorum; the actual mining was done by the prospectors or lessees (conductores) and later by companies (societates).⁸² The chief technological improvement in the Romano-British iron industry was the introduction of the shaft furnace 5-6 ft. high, in place of the more primitive bowl furnace which was little more than a shallow hole in the ground. The manufacture of charcoal for smelting would have been an essential part of these operations, and implies organized forest management for charcoal production probably by slave labour. Charcoal has been found at many of the Roman metal-working sites known in Wales, reviewed for example by Wheeler⁸³ and more recently by Kelly.⁸⁴ Major metal-working areas in Wales included Flintshire for lead, Anglesey for copper, Monmouthshire and Glamorgan for iron, and Pumpsaint in north Carmarthenshire for gold.

2. Forests in Dark Age Wales to Domesday

Roman power in Wales lasted a little over three centuries, coming to an end in the last quarter of the fourth century AD. The five or six centuries following the end of the Roman occupation are 'Dark Ages' in Welsh history, for which few contemporary sources of documentary evidence exist. During this period the development of the forests of Wales must be largely a matter of conjecture and of inference of general trends from archaeological studies of individual sites. The main characteristics of the period are an overall growth of population in Wales, a general movement of population towards valley settlements, penetration and colonization of new areas by settlers, the growth of ecclesiastical settlements, intermittent tribal warfare, and ravaging of the border region and coastal areas by Anglo-Saxons and sea-raiders. The pollen record exhibits a continuing decrease in the proportion of tree pollen during the period. With the withdrawal of the Romans the arable area probably decreased, but the formerly prevalent idea of a predominantly pastoral society has been considerably modified by recent scholarship.⁸⁵ Gildas' statement 'montibus alternandis animalium pastibus maxime convenientibus' (mountains of the greatest convenience for alternate pasturage of stock)⁸⁶ describes the widespread practice of transhumance in the 6th century, but archaeology has also revealed substantial evidence of arable economy in Wales during the Dark Ages.

Culhwch ac Olwen, the earliest Arthurian tale in Welsh, gives glimpses of a primitive social code, with subject matter 'perhaps coeval with the dawn of the Celtic world',⁸⁷ including a graphic description of forest clearance by slash-and-burn agriculture (cf. previous chapter, p.19). In the tale, Ysbaddaden

Pencawr (Chief Giant) sets his first task to Culhwch: 'Dost see the great thicket yonder?... I must have it uprooted out of the earth and burnt on the face of the ground so that the cinders and ashes thereof be its manure; and that it be ploughed and sown so that it be ripe in the morning against the drying of the dew'.⁸⁸ Forest clearance for temporary or permanent agricultural usage had an immediate effect, but livestock grazing too would have adversely affected the forest over a long period for much of the grazing would have been in open woodland or wood pasture, and its long-term result would be the elimination of regeneration and the eventual degradation and destruction of the forest.

Some hill forts remained in use in the post-Roman period, but the valley-ward settlement following lines of least resistance, as postulated by Hughes,⁸⁹ would have involved clearance first of the valley sides with smaller trees and later the valley bottoms carrying oak of large diameter. At Dinas Emrys, a hill fort near the southern end of Nant Gwynant, pollen analysis indicates that the natural woodland of the valley had already been cleared fairly extensively in the early Dark Ages. This early clearance was followed by a period of reduced human activity or recolonization by natural forest vegetation, before further clearance in the later Dark Ages.⁹⁰ The actual timing of these phases is not definite, but this alternating pattern of clearance and abandonment must have been repeated many times at various places throughout Wales, often as a result of tribal warfare. This process of alternation is vividly described in another passage in Culhwch ac Olwen, when the ancient Owl of Cwm

Cawlwyd says: 'When first I came hither, the great valley you see was a wooded glen, and a race of men came thereto and it was laid waste. And the second wood grew up therein, and this wood is the third'.⁹¹

At Dinas Powys (Glamorgan), apparently the court of an important ruler in the 5th and 6th centuries, stock-raising was the main basis of the economy, but arable cultivation was also important. The evidence of large numbers of pigs implies the existence of extensive woodland nearby, providing pannage for pigs and also hunting territory.⁹²

At Aberduhonw (Breconshire) a study of the history of land-use indicated that after the departure of the Romans, Irish immigrants cleared and settled the area. Repeated human interference caused degradation of the woodland which eventually failed to regenerate. The valleys were used for corn and pasture, and trees were left only on slopes where steepness made ploughing impossible. Grazing animals moved through these woods, seeking upland and lowland pastures and doubtless destroying any natural regeneration en route.⁹³

Sir Cyril Fox, in his field survey and interpretation of Offa's dyke, concluded that irregular or sinuous alignment of the dyke indicated the presence of forest when the dyke was built in the late 8th century; that straight alignment indicated cleared and cultivated areas, i.e. the arable or pasture fields of a settled agriculture; and that wide gaps in the dyke are likely to indicate areas of very dense damp oak forest. In this way it may be possible to use the dyke as a transect indicating land use through the borderland from the Dee to the lower Severn in the late 8th century.

As an illustration of this approach, a section of Offa's dyke in Montgomeryshire is interpreted as follows 'the area between the Vyrnwy and Severn was arable and meadowland; a narrow belt bordering the Severn near Buttington up to the 300-ft. contour was arable, above that was woodland, above that again forest (waste); the short straight stretches at the 800-1,000-ft. level in Leighton parish represent ... open downland ... From Rownal to within a thousand yards of the Caebitra there was thick woodland; thence to the Caebitra was arable. Passing upwards through another belt of woodland the crest of the Mellington Hall spur is reached'.⁹⁴ This picture, which can be repeated by analysis of other sections of the dyke, shows that by the 8th century the extensive coherent tracts of forest had already been broken up into smaller units, i.e. individual woods and forests. Maps of woodland recession and advance of settlement in Cheshire, Shropshire and Herefordshire⁹⁵ show, on the basis of place-name elements such as leah, grove, hurst, etc., that most of the Welsh border was woodland until the late Anglian period. From the place-name and archaeological evidence, Sylvester concludes that the Angles almost certainly first settled 'in those parts of the Borderland where the initial work of clearing the primitive [sic; primeval] woodlands had already been done by the Brythonic tribes, and that these Brythons were sufficiently advanced beyond the stage of nomadic pastoralism to have considerable numbers of permanent or, at worst, winter quarters in the lowlands'.⁹⁶

The basic territorial framework of settlement was probably already established even before the Roman occupation, and the territorial organization of Wales in the period between the

Romans and the Normans was far more stable than earlier investigators have envisaged.⁹⁷ Even the poorest land was unlikely to have been regarded as a free commodity, and by the mid 9th century settled rights in land were already old-established in Wales. Three main types of land-holding are recognized,⁹⁸ viz. tir gwelyog, tir cyfrif and tir corddlan. The tir gwelyog (hereditary land) was the normal land tenure, the right to which passed to descendants in equal shares and the rights of the 'owner' (perchennog) were limited to his lifetime. A hereditary proprietor would have a personal holding of appropriated land (tir priod) and a share of joint land (cytir) which would embrace wood, pasture and waste subject to joint control but within which the proprietor exercised proportional rights calculated in terms of his acreage of appropriated land. The other types of holding were tir cyfrif (reckoned land), the tenure appropriate to villeins, and tir corddlan (nucleal land) shared as 'gardens', i.e. strips.

Documentary sources that can be used, with caution, to shed light on the forests of Wales in the Dark Ages are The Book of Llandaff (Liber Landavensis) and the laws traditionally called the Laws of Hywel Dda. The Book of Llandaff, in its present form mainly a compilation of the second half of the 12th century, was written to magnify the greatness of the diocese of Llandaff and to underline its claims to territory and privileges; its references to earlier centuries cannot necessarily be taken at face value.⁹⁹ Similarly, the earliest

surviving Latin and Welsh versions of the Laws attributed to Hywel Dda (Hywel the Good), king of all Wales from 942 to 949 AD, date from the second half of the 12th century and later. Though the Laws include matter that is not incompatible with Welsh conditions in the 10th century, the information they contain cannot be assigned with certainty to the 10th century, but it does relate in a general way to forest conditions in Wales in the 10th to 12th century.¹⁰⁰ The earliest surviving versions of the feudal forest laws of Scotland (Leges Forestarum) date from the late 14th century, but Anderson thinks it reasonable to suppose that the earliest laws existed from the mid 12th century and perhaps earlier.¹⁰¹ These laws include sections entitled 'De silva prohibita', 'De pannagio in foresta', 'De homine intrante forestam' etc. Comparison of the Scottish Leges Forestarum, and the forest sections of the Leges Visigothorum,¹⁰² with the Welsh laws would be of interest.

The boundaries described in The Book of Llandaff¹⁰³ include numerous references to groves, woods and forests (luin, guid, coit), and indicate that much of south-east Wales was still well wooded. The boundaries frequently went through a wood (trui coit), and sometimes along a dyke or bank through a wood, but in many cases the margin of the wood itself served as the boundary. The role of wood-banks as ancient boundary markers has been explained by Rackham.¹⁰⁴ The tree species mentioned as boundary features, marker trees or as woods in The Book of Llandaff include avallen (apple), banadil (broom), guern (alder), helic (willow), onnenn (ash), and iuenn (yew).

Many woods are mentioned in The Book of Llandaff, but very few are named. The named woods include

Coit Guent = Wentwood (S. Monmouthshire)

Luin Ili = Ely Wood (mid Glamorganshire)

Luhin Latron = Thieves Wood (Gower, ? Clyne Wood)

The Gelli Irlath named in a marginal entry (Chad 4) in The Book of Llandaff is probably the Gelli Wood on the bounds of the medieval forest of Pennant in Carmarthenshire.¹⁰⁵

Although much of Wales was still forest land, it is difficult to gain a clear picture of the forests themselves, their ownership and management from the casual references to forests in the Laws.¹⁰⁶

There was probably little systematic exploitation of the forests which were largely free for tribal use for hunting and as a source of fuel and other forest products, under various regulations and restrictions aimed broadly at game conservation and, indirectly, forest conservation. Repeated cutting of underwood for fuel and occasional removal of larger trees (oak) for construction timber would tend to produce coppice, perhaps with standards, in the neighbourhood of settlements, or an irregular selection forest further afield.

The value of woodland was recognized in the definition of the legal rhandir (a tribal unit of land) which consisted of 312 acres, of which 300 were arable, grazing and fuelwood (cynnut), leaving 12 acres for the buildings of the settlement.

Woodland is generally mentioned in the Laws simply as coet, without qualification. Reference is also made to coet cadw (preserved woodland), a legal descriptive term for a particular category of woodland reserved for pannage and for the regulated harvesting of forest products. This does not imply, however, that the exploitation of other woodland was entirely unregulated. Woodland (tyr coet) was distinguished from waste or wasteland (tyr guyd). The term for reserved woodland (coet cadw) developed from describing a particular category of woodland to become fossilized as a forest place-name at several sites in Wales, e.g. at Nyfer (Pembrokeshire, 1434), Diserth (Flintshire, 1474) and Pendeulwyn (Glamorgan, 1568).¹⁰⁷ At Llaniestyn (Anglesey) there is a recorded history of the place-name Coed Cadw applied to the same wood for nearly seven centuries, from at least 1305 to the present day*. For a long period this particular wood was often

*The following list summarizes the documentary evidence of the name over the centuries:

1305	Coedcadw (PRO Roll 767) —
1391	Coydcado (Cal. Patent Rolls 85)
1438	Kyngeswode alias Coide Cadowe (Cal. Patent Rolls 156)
1568	Kingswood alias Coed cadw (Bangor MS. 1920, vii)
1653/4	Kingswood alias Coyd Cadowe (Cal. Wynn Papers 2037, 2039)
1669	King's Wood, Coed Cadw (Fenton, Tours in Wales, 304)
1840	Coed-cadw (OS 1st ed.)
1956	Coed Cadw (OS 23/57)

also called Kingswood, the name obviously indicating the original ownership of the wood.¹⁰⁸

The various versions of the Welsh laws also refer to fforest y brenin (the king's forest). Here the term fforest is apparently used in the legal sense meaning land where forest law applied, i.e. land reserved for royal hunting and originally largely wooded but not necessarily still woodland (cf. p. 75). Three special categories of timber could be cut free even in the king's forest, viz. wood required for the roof of a church (pren crib eglwys), spear shafts (peleidyrr) to be used in the king's service, and timber for a funeral bier (elor). The Laws show that large timber was extracted by horses or oxen, a horse-load being equivalent to that of two oxen; smaller assortments, especially fuelwood, were carried as man-loads.

The Laws also contain references to forests or woodlands that apparently were in some degree of private ownership, but even in these woods some essential construction timber assortments, i.e. for a ridge beam (nenbrenn) and two crucks (nenfforch), could still be cut even without the permission of the owner of the wood. Owners were allowed to kill swine doing damage in the woods (see p. 47), and received a recompense of one penny

for each horse-load or double-oxen load of timber felled without permission.

Deforestation or assarting was not allowed except by agreement of co-proprietors. When a person cleared woodland with the owner's permission, he could hold the land for four or five years; in the next year it was returned free to the owner. No brother was allowed to clear woods belonging to another brother 'without yielding him wood equal to that cleared by him', or equivalent compensation. The period of time for which the cleared land could be held is similar to the probable duration of occupation of areas cleared in slash-and-burn agriculture, before manuring became necessary (cf. p.20).

Pannage in the preserved woods (coet cadw) was reserved to the animals of authorized persons during a defined season in autumn and early winter, viz. from a few days before the feast of St. Michael until the fifteenth day after Epiphany. These woods were guarded, and the entry of foreign swine into the woods during this close season was an act of trespass to be compensated for or punished as such; generally the specified penalty was to kill every tenth swine up to a total of nine, and every one thereafter. The increasing value of pigs was defined by the age at which they were turned into the woods, and by the pannage periods.

Whoever felled a tree on the king's highway was liable to a fine (camlwrw) of three kine to the king, and the worth of the tree. He was also liable to clear the way for the king, and also to cover the stump of the tree (bon y pren) with cloth of one colour as the king went by.

No office of forester in the modern sense existed. The falconer (hebogydd) and the chief huntsman (pen-cynydd) held high positions in the court hierarchy, indicating the great value placed on hunting as a royal and courtly pastime. The game laws are detailed and throw interesting light on certain early concepts of property, but are of no significance for the forests as such. The woodman or fuel-gatherer (kynnudwr) was a low-grade official, not included in the 24 officers of the court. He held his land free, and his protection was specified as 'to the farthest place he goes to collect firewood (kynnut) and as far beyond as he can throw his bill-hook.' The worth of slaves is specified in the Laws at a pound for a native, and half as much again for a foreign slave. If the slave was employed as a woodman (coetwr), his billhook or hatchet was valued at one penny. The Laws show that wood, not peat, was still the main source of fuel in this period.

The following table lists the tree species that are explicitly mentioned at various places in one or more versions of the Laws.

Table 5. The tree species named in the Welsh Laws.

English name	Welsh name (variant spellings not given)	Latin name
alder	gwern	alnus
apple	avallen per	pomus dulcis
ash	on	fraxinus
beech	ffawyden	fagus
crabapple	avallen sur	pomus amara
elm	llwyf	-
hazel	kollen	corilus
oak	derwen	quercus
thorn	draenen	spinel (spina)
willow	helyc	-
yew	ywen	taxus

The values of most of these trees are specified, but some of the values differ in the various versions of the Laws. The following figures are therefore of interest primarily in comparing the relative values of the trees. Oak was the commonest species in Wales, and was always the most valuable forest tree, its worth being put at 120 pence, i.e. twice the value of a standard cow, which was worth 60 pence. If the oak had two boles, they were valued at 60 pence each, and a main branch or branch reaching the heart of the tree was valued at 30 pence. If an oak tree was bored through in the search for wild honey, the payment due was 2⁴ pence or 60 pence to the owner of the tree and a fine (camlwrw) to the king. In contrast to a high-forest oak, a scrub oak (kekyn deruen) not bearing fruit was worth only 4 legal pence.

A beech tree was generally valued at 60 pence, i.e. half the value of an oak; beech was not included in versions from north Wales because it did not grow there, and in two versions from south-east Wales it was equated with oak in value, viz. 120 pence. An apple tree was valued at 60 pence, and a fruiting crabapple was worth half as much. A crabapple before it fruited was worth only 4 pence. A hazel was valued at 15 pence, and a thorn half as much. In another version, a hazel grove (colluyn) was valued at 2⁴ pence, and one hazel from the grove at 4 pence; any tree bearing fruit (except oak and apple) was valued the same as the hazel grove. Any other tree not bearing edible fruit (such as ash, willow or alder) was worth 4 or 6 pence, if it was alive and growing. Main branches of these inferior trees, reaching the heart of the tree, were valued at one penny. A holy or churchyard yew (ywen sant) was worth a pound; a woodland yew (ywen goet) was worth only 15 or 30 pence. Birch, holly and poplar, the other common native trees, are not named but were presumably valued as trees not bearing edible fruit. Significantly, pine is not mentioned at all (cf. p. 25).

Trees planted for shade or shelter (e.g. as windbreaks) were specially valued, and this is one of the earliest references to deliberate tree planting in Wales: 'Every tree planted for shelter is of twenty-four pence value to its owner, whether planted within a garden, or as a shelter to his house'¹⁰⁹. Towards the end of his reign, Gruffydd ap Cynan (c. 1055-1137), king of Gwynedd, is said to have improved the husbandry in his kingdom, by planting old woods (a hen koedydd ag eu plannu) and making orchards and gardens.¹¹⁰ The reference is somewhat ambiguous but apparently indicates the renewal of old woodland (exhausted coppices or senescent high forest) by underplanting or replanting.

Techniques of vegetative propagation were known and practised. A graft (h ymp), presumably apple, was worth four pence until the end of the year in which it was grafted; thereafter it increased in value by two pence each year until it started to fruit, whereupon it was valued at 60 pence.

Table 6 compares values of trees in the three main groups of Laws.

Table 6. Values of trees in the Welsh Laws.

Tree species	'Dimetian', pence,	'Venedotian', pence,	'Gwentian', pence
oak	120	120	120
each stem of a forked oak	-	60	-
main branch of oak	30	30	30
scrub oak	-	4	-
hazel grove	-	24	-
hazel	15	4	15
crabapple (fruiting)	30	30	30
crabapple (non-fruiting)	-	4	-
apple	60	-	60
fruiting graft (? apple)	-	60	-
ash	-	4	-
alder	-	4	-
willow	-	4	-
churchyard yew	£1	-	£1
woodland yew	15	30	15
beech	60	-	60 (120)
thorn	7½	-	7½
planted shelter tree	-	24	-
fruiting tree	-	24	-
non-fruiting tree	6	4	4

The table shows that fruit and mast were very important factors in determining the relative values of trees. The same pattern is seen in the laws of the Visigoths which specified similar tree values or fines for illegal felling of various species of trees. In these laws, the olive, apple, large oak, and small oak were valued in the ratio 5,3,2 and 1 respectively.¹¹¹

Criminal punishments were not imposed for unworked trees, i.e. felled trees green or dry, untrimmed at butt or top. Worked constructional timber was highly valued, however. For example, the following specific items were valued in a winter dwelling: each cruck 20 pence; the roof-tree (ridge-beam) 40 pence; and 4 legal pence for each of the pillars, benches, stanchions, door-posts, sills, lintels, side-posts and doors. The crucks were presumably prepared by selecting an oak with a branch at the correct angle, felling the tree and cutting it longitudinally in two, to produce two identical cruck-blades. Examination of medieval crucks in Monmouthshire indicates that the curve of the cruck follows the natural grain of the wood, and that the crucks in situ in the building are upside-down relative to their original position in the tree, i.e. the branch forms the short base leg of the cruck blade and the butt end of the tree is at the ridge of the roof.¹¹²

Other wooden articles, the values of which vary in the various versions of the Laws, include willow buckets and pails, yew pails, elm-bark rope and vats or tubs made of solid wood or of several pieces of wood.

Saws had been known in Wales at least since the Bronze Age (cf. p.36), but they do not feature prominently in the quite detailed lists of tools and implements in the Laws. The following table lists the main forest tools and their values.

Table 7. Forest tools and their values.

Welsh	English	Value
bwyell lydan	broad axe	4 legal pence
bwyell gynnut	fuel axe	2 " "
llaw vwyell (bvyall uechan)	hand axe	1 " penny
nedyf	adze	1 legal penny
gwdyf	hedging bill	1 legal penny
bilwc	bill-hook	1 " "
gylyf	bill-hook	1 " "

Scattered references to forests and trees occur in other sections of the Laws, for example, those dealing with personal injuries. If someone was killed by a falling tree, the feller was liable to pay compensation (galanas or sarhad) to the victim's kindred if he gave no warning, but if warning were given, no compensation was due. Again, if 'two persons be walking through a wood, and a branch, by the passing of the foremost, should strike the eye of the hindmost, unwarned, let him be paid for his eye, if he lose it: but, if the other warned him, he is not to pay'.

Trees were important as boundary markers, and were also concerned in boundary disputes. If a tree fell across a river that formed the boundary between the lands of two persons, the owner of the land from which the tree grew had a right to the tree.

The great Domesday survey of England in 1086 covered some parts of the borderland that are now in the Welsh border counties. Domesday itself is a valuation list and it is difficult or impossible to derive accurate details of the extent, location and type of woodland from the Domesday Book. Woodlands were generally measured in terms of length alone, or length and breadth, the units of measurement being the league (probably = $1\frac{1}{2}$ miles), furlong and perch. Some woods were measured in acres, others were accorded cash valuations, and in some places woods were measured by their swine-fattening capacity. Some underwood was noted, but not consistently. There is little or no descriptive detail, e.g. on the species, age-classes, management or products of the woods. The terms used include woods, small woods, very small woods, large woods, woods yielding ... shillings or pence, unproductive woods, pasturable woods, brushwood, spinney, underwoods, etc. Names of woods are not given in Domesday. It is not possible to correlate the dimensions expressed in leagues, acres and swine measures, and 'it would be rash to make any assumption about the superficial extent of woodland measured in this way',¹¹³ i.e. in terms of length only, or even length and breadth. 'Waste' in Domesday implies not the natural waste of mountain, marsh or heath, but land that had gone out of cultivation, mainly as a result of deliberate devastation. Considerable areas of waste were recorded along the Welsh border. 'Forest' is used in the sense of hunting ground where forest law applied.

Of the many dozens of entries for places now within the Welsh border counties, a few typical entries may be presented as examples:

Biscopestreu (Bistre, Flintshire): 'There is a wood 1 league in length and half a league in width. There is a hawk's

eyry. The earl has this wood which has been placed in his forest'.
Ros and Reweniou (Rhos and Rhufoniog, Denbighshire):

'There is land enough for 20 ploughs only ...
 All the rest of the land is woods and moors,
 and cannot be ploughed'.

Sutone (Soughton or Sychdyn, Flintshire): 'There
 is wood half a league long and 4 acres wide.
 In these 20 hides the earl has all the woods
 which he has put into his forest, whereby the
 manors are much depreciated. This forest is
 10 leagues long and 3 leagues wide. There are
 4 eyries of hawks'.¹¹⁴

Lestone (Leighton or Tre'r-llai, Montgomeryshire): 'wood
 there 2 leagues long, and it is sufficient for
 fattening 200 swine'.

Cirestoc (Churchstoke or Yr Ystog, Montgomeryshire):
 'wood there for fattening 100 swine'.¹¹⁵

Chenistetone (Knighton, Radnorshire): 'a great wood is
 there'.¹¹⁶

However, an absence of woodland entries in Domesday
 does not necessarily mean an absence of actual woodland.
 For example, the Forest of Dean is not clearly demarcated
 precisely because of the small population in and around the
 forest, and woodland is never recorded for the territory of
 Gwent (in modern Monmouthshire), which was certainly well
 wooded at the time of Domesday, and has remained the best
 wooded of all the Welsh counties throughout the Middle Ages and
 indeed right up to the 20th century (cf. Table 45, p. 293).

Although Domesday does not record woodland in Gwent, it does indicate the existence of an established timber export trade via the Wye, for tolls were paid at the new castle of Estrighoiel (= Chepstow) by ships going to the wood (de navibus in silvam euntibus).¹¹⁷

In a part of the border now in Radnorshire, the Domesday entry reads 'on these waste lands there have grown up woods [in his wastis terris excreverunt silvae] in which Osbern hunts, and thence he has whatever he can take'.¹¹⁸ This natural succession of woods on abandoned and devastated lands was probably the result of Welsh raids in 1055, and the woods therefore would be some 30 years old at the time of the Domesday survey.

The general picture of the Welsh borderland as given by Domesday confirms the earlier interpretation, e.g. of Offa's dyke, that there was certainly still a good deal of woodland, some of it secondary, along the whole length of the border from the Dee to the lower Severn. Some large forests were recorded, e.g. 10 x 3 leagues in extent, but woods or woodlands were generally smaller, e.g. 1 x 1 league; some very small woods were recorded, e.g. 1 acre or 40 x 40 perches. This indicates that even in the fluid conditions of the border at this period, fixed and distinct areas of woods and forests were already a feature of the landscape. Management, where it existed at all, may be assumed to have been utilization of dead fallen wood, underwood and small coppice stems, with occasional felling of larger coppice stems or maiden trees for special purposes, especially building.

CHAPTER III

FORESTS IN THE MIDDLE AGES

1. Military significance of forests
2. Forests and woods in Medieval Wales and their utilization
3. The monasteries

1. Military Significance of Forests

After his conquest of England, William I set up the great earldoms of Hereford, Shrewsbury and Chester, and the Normans soon turned their attention to Wales, conquering large territories in eastern and southern Wales. In some areas the remaining forests of Wales were still sufficiently extensive and dense to prove a formidable physical barrier to invading forces, and were also of considerable strategic importance. Repeatedly over some two centuries, at various places throughout Wales, forests featured as scenes of battles, being used by the Welsh both as places of ambush and guerrilla warfare against foreign invaders, and also as places of refuge and shelter from enemies, whether foreign or Welsh. The military and political details of this period of two centuries of Norman encroachment, occupation and intermittent forest warfare have been described in detail,¹¹⁹ but the role of the forests has never been considered per se. The extent and military importance of the Welsh forests were clearly realized and described in the middle of this period by that percipient observer Giraldus Cambrensis in his Itinerarium Kambriae (1188) and Descriptio Kambriae (1194) which together form one of the first detailed descriptions of Wales as a country.¹²⁰

Giraldus described Wales generally as 'a country very strongly defended by high mountains, deep valleys, extensive woods, rivers, and marshes'. The Welsh 'neither inhabit towns, villages nor castles, but lead a solitary life in the woods, on the borders of which they ... content

themselves with small huts made of the boughs of trees twisted together, constructed with little labour and expense, and sufficient to endure throughout the year'. Apart from these general references to the well-forested nature of much of Wales, Giraldus specifically mentioned woods in the territory between Wye and Usk where the land 'is well stored with pastures, woods, and wild and domestic animals'. At Llanthony the monks 'would not suffer the thick and wooded parts of the valley to be cultivated and levelled'; these woods were 'well stored with swine and goats' though the tops of the surrounding mountains were 'covered with grass'. This description shows that the combined effects of climatic change and human influence had resulted in a marked lowering of the treeline, but that the lower slopes and valley bottoms were still densely wooded. In the Grwyne valley was the 'narrow woody tract called the bad pass of Coed Grono', where Richard de Clare was ambushed and killed in 1135; between the Rhymney and Taff lay the 'mountainous and woody country' of Ifor Bach. Further west, Maurice de Londres had a hunting forest in the neighbourhood of Cydweli; Carmarthen was surrounded by woods and pastures, the Cantref Mawr was a safe refuge 'on account of its thick woods', and the castle of Dinevor (Dinefwr) was 'strongly situated in the deep recesses of its woods'. The coastal area around St. Davids had no woods, but at the sands of Niwegal (Newgale, Pembrokeshire) Giraldus recorded the remains of the submerged prehistoric forest:

'the trunks of trees cut off standing in the very sea itself, the strokes of the hatchet appearing as if made only yesterday ... the wood like ebony' (cf. p.25). In north Wales, the only wood specifically mentioned by Giraldus was 'the wood of Coleshulle' (Coleshill, Flintshire), scene of a defeat of Henry II in 1157 (cf. p.60).

Giraldus noted that in Wales 'the battle is ... here in forests', and pointed out the superiority of light infantry over cavalry 'when the engagement is in narrow defiles, in woods and marshes', and the advantages of a winter campaign 'when the trees are void of leaves'. In fact, these measures were adopted successfully a century later, and it was during these two centuries of intermittent forest warfare that successive kings of England formulated and implemented the first 'forest policy' for Wales, viz. systematic felling and permanent clearance of passes and large tracts of woodland to form safe areas, and subsequently the introduction of a selective logging industry providing large quantities of hardwood timber for the building and maintenance of castles.

The need to eliminate certain forests as places of ambush and shelter was brought home to the Normans by the events of 1094, 1095 and 1097.¹² In 1094 the Normans under William II were defeated with great slaughter at Coedysbys (a wood the site of which has not been identified). A year later, in 1095, the Welsh 'sought a defence in their woods and wildernesses' and William had apparently intended to cut down all the woods and groves, but was obliged to

return to England after a fruitless campaign. The same thing happened again in 1097 with the Normans 'not daring to invade the woods or the wilderness against the Britons'. In 1157, in a campaign against Owain, prince of Gwynedd, Henry II was ambushed in a wood called 'the wood of Hawarden', and after severe losses he narrowly escaped 'to the open country'. The actual scene of the battle has traditionally been called the wood of Coleshill, but recent reassessment of the evidence locates the battle somewhere between Ewloe and Hawarden,¹²² a region which Domesday Book notes as containing considerable areas of woodland.

Though Magnus, king of Germany,^{*} had felled trees in Anglesey during a raid there in 1102 to provide timber for castle-building on the Isle of Man,¹²³ the first recorded felling of Welsh forests by invading forces as a matter of deliberate strategic policy since the Roman conquest was in 1165 when Henry II, in an effort to resolve a military stalemate, 'moved his host into the wood of Dyffryn Ceiriog, and he had that wood cut down, and felled to the ground'.¹²⁴ This was the first act of a policy that was continued for well over a century and was to have a profound effect on the forest area of Wales. In 1223, Henry III ordered that effective help be given in the cutting down of forests and the clearing of passes to provide free and safe passage and access to the townships of Cardigan and Carmarthen for merchants and others (efficax ei auxilium faciatis ad boscos prosternendos et passus sciendendos ut liber et securus pateat transitus et accessus ad villas nostras de Kardinan et Kaermerdin mercatoribus et aliis).¹²⁵ For strategic reasons, in 1224 Henry III

^{*}i.e. Norway.

commanded all soldiers and others owning woods around the castle of Montgomery:

Mandamus vobis quatinus boscos vestros quos habetis circa castrum nostrum de Muntgomery prope passus et vias publicas sine dilatione, sicut tenementa vestra diligitis, prosterni faciatis et essartari. Quod nisi feceritis, sciatis quod nos pro communi utilitate boscos illos prosterni et essartari faciemus et in dominicum nostrum convertemus.¹²⁶ (Inasmuch as you value your tenure, we order you to cut down and assart your woods which you own around our castle of Montgomery near tracks and public roads, without delay. If you do not do so, take notice that we, for the common good, shall have those woods cut down and assarted and convert them to our ownership).

Montgomery occupied a key strategic position, and extensive and repeated fellings were made in this area throughout the 13th century. In 1228 the Welsh forced the invading forces to retreat, but not before extensive military felling of forests had taken place near Montgomery, probably at Ceri: the king 'went to the said wood which was verie large, being five leagues in length and, by reason of the thicke growthe of the wood, verie hard to be stocked (i.e. cleared); howbeit, the king caused the same, with great diligence and trauell, to be assarted and consumed with fire'.¹²⁷ Again in 1251 the king ordered an inspection of the forest passes at 'Kery et Kedewy' (Ceri and Cedewain, west of Montgomery), but if the passes were sufficiently wide, the men of Montgomery were forbidden to lay waste those forests or those of free tenants.¹²⁸ This is one of the first regulations specifically prohibiting excessive felling of forests in Wales. In 1278,

Bogo de Knovill was appointed 'to cause to be cut down all hays and thickets (densitates) in the ways in the parts of Mundgomery, Kery, and Kedewy, which give rise to danger to the passers by, homicides and robberies and other enormities committed there, and ... to admonish ... the lords of those lands to cut them down, and, in case of their refusal to do so, to cause it to be done at their cost'.¹²⁹

The abuse caused by felling in places other than those required for military passes occurred elsewhere beside the case at Montgomery mentioned above. For example, at the pass of Swerdwode near Mold, where people of the Wirral and Chester 'cut throughout and everywhere at their will. And thus they waste this wood, and cut it, beside the passes, and not at all in the pass'.¹³⁰

There is no way of making even a rough estimate of the total area of forests permanently or temporarily cleared in Wales as a result of military fellings during and between the various campaigns, though it is certain that the clearances were extensive and were deeply resented by the local population. Fig. 4 shows most of the places or regions specifically named as areas where clearances took place in the 12th and 13th centuries, but general orders were also given to numerous individuals to make clearances on the lands for which they were responsible, and the forest clearances were in fact much more widespread than can be indicated by the map.

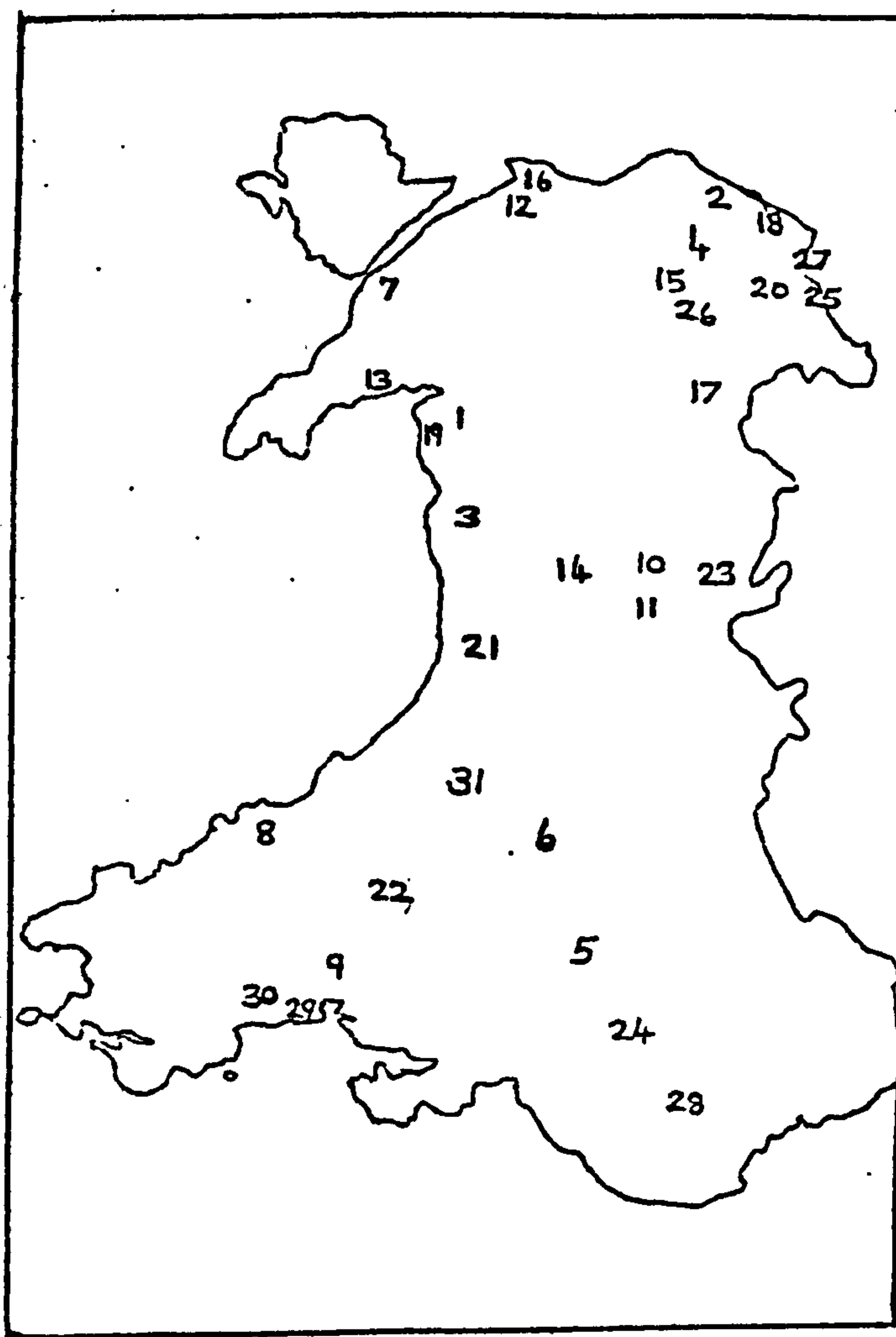


Fig. 4. Sketchmap showing general areas of known military fellingings in the 12th and 13th centuries (based on Cal. Welsh Rolls, Cal. Close Rolls, Cal. Patent Rolls).

- | | | |
|--------------------|---------------------|--------------------------------------|
| 1. Ardudwy | 11. Ceri | 21. Llanbadarn |
| 2. Basingwerk | 12. Conway | 22. Mallaen |
| 3. Bere | 13. Cricieth | 23. Montgomery |
| 4. Bodfari | 14. Cyfeiliog | 24. Morlais |
| 5. Brecon | 15. Denbigh | 25. Pulford |
| 6. Buellt (Builth) | 16. Degannwy | 26. Ruthin |
| 7. Caernarfon | 17. Dyffryn Ceiriog | 27. Swerdewod |
| 8. Cardigan | 18. Flint | 28. Taff |
| 9. Carmarthen | 19. Harlech | 29. Talacharn |
| 10. Cedewain | 20. Hope | 30. Whitland |
| | | 31. Ystrad Fflur
(Strata Florida) |

Something of the organization and scale of the forest clearance operations can be deduced from the surviving accounts of the campaigns of 1277, 1282-3 and 1294-5, and records of the intervening periods. The axe and the flame were weapons just as important as the lance and the bow.

In the 1277 campaign, Edward's plan was to advance into Wales from a strong base, guarding his workmen cutting through the forest, and then creating a new base from which to repeat the process.¹³¹ This involved the cutting of an invasion road for over 30 miles from Chester to the river Conway, at great speed, between April and August 1277. The road was cut in three sections: (I) from Chester to Flint; (II) from Flint to Rhuddlan; and (III) from Rhuddlan to Degannwy. The felling and building operations were carried out by large numbers of specialist workmen, recruited from the English Border and Midland counties. The workmen included sawyers (cissores bosci), wood-cutters (coupiatores), carpenters (carpentarii), diggers (fossatores), masons (cementarii), and charcoal-burners (carbonarii), some of the latter coming from the Forest of Dean.

Active felling was in process throughout April at the pass of Pulford (on the modern border), as shown by letters from William de Beauchamp to Edward I.¹³² These state that the workmen were cutting as hard as they could, and that the pass has been cut across completely at a place which had never previously been cut. Some of the timber felled was sold, and efforts were made to sell as much as possible at the best possible price, but large amounts of smaller trees, slash, brush and stumps must have been burnt. On section II of the road, between

Flint and Rhuddlan, 1500-1800 woodmen were engaged, and 700-1000 on section III, from Rhuddlan to Degamwy.¹³³ The workmen were carefully guarded, not only for protection but also to prevent desertions, though the men were always paid. Their numbers varied from week to week, as a result of injuries, desertions, movement of labour, and new recruiting. Some of the timber felled was doubtless used in the temporary strong-posts built at Flint, Rhuddlan and Ruthin, but large amounts of specially prepared timber assortments were also shipped in for this purpose from Chester.

It is possible to venture a very rough estimate of the actual amount of clearance work involved in the making of this particular forest road. In the Edwardian campaigns, whenever the road clearance width was specified, it was one bowshot in breadth (in latitudine baliste contineat unum tractum).¹³⁴ Expert estimates put this at 200-250 yards,¹³⁵ and this is in broad agreement with the width laid down by the Statute of Winton (1285),¹³⁶ viz. clearance of 200 ft. on either side of the actual roadway, say $(2 \times 200 \text{ ft.}) + 50 \text{ ft.} = 150 \text{ yards.}$ Assuming a minimum width of clearance of 150 yards, an average of 200 and a maximum of 250 yards, and assuming that clearance was actually needed on 10, 20 or 30 miles of the route, then the possible range of acreages of forest cleared is as follows:

Area of woodland felled, in acres

Length cleared	Road widths		
	150 yd	200 yd	250 yd
30 miles	1636	2181	2727
20 miles	1090	1454	1818
10 miles	545	727	909

The probability is, then, that some 1000-2000 acres of woodland were felled and cleared in the space of 4-5 months to make this one road alone.

The years following the 1277 campaign saw a series of royal instructions for systematic felling of Welsh forests to make lines of communication safe. The stated justification for felling was that the forests harboured robbers and murderers, but the fellings were resented by the Welsh, and the grievance was partly responsible for subsequent uprisings.

Fellings were made e.g. in 1278 in the Montgomery region, between Carmarthen and Brecon, in the territories of Strata Florida and Talacharn, the Bohun territory (Brecon), and at Swerdewod (between Mold and Kinnerton)¹³⁷. In 1280, felling and assarting was ordered at Strata Florida, Whitland, and between Carmarthen and Brecon; in the same year, Gelli wood (at Whitford, Flint) was given to the Abbot of Basingwerk on the condition that it was cleared within three years, and the king granted his woods in the Rhuddlan area to be rooted up, the people doing the clearance to have the land rent-free for three years.¹³⁸ This rent-free period of three years for

holding the cleared land again recalls the period specified in the Welsh Laws (cf. p.47) and the duration of land-utilization in primitive slash-and-burn agriculture (cf. p.20).

The freedom and encouragement given to people to destroy forests may be seen from a proclamation dated 5 February 1278. Foresters were prohibited from exacting any fee 'for trees felled or to be felled or to be rooted up in Swerdewood and in the woods between Mold and it or elsewhere in the four cantreds', and 'all who wish may take and have freely at their pleasure of the woods in those passes until the passes be fully cleared, and when the passes shall be thus cleared, then from the woods beyond the passes at their will; and that all who wish thus to take or carry away from the woods shall have free passage in going and coming and in removing and carrying away the wood ... and that no one shall hinder them ... until the king shall otherwise order'.¹³⁹

The main plan of campaign in the war of 1282-3 was the same as in 1277, though it was more difficult to carry out.¹⁴⁰ Again, forest clearance played a vital part in the War. Large number of woodcutters (coupiatores) and charcoal-burners (carbonarii) were recruited, and they were all picked men: 'the most powerful, agile and most accustomed to the execution of these offices'. Each of them was to have a good strong axe or hatchet (hachiam vel securim) suitable for felling large and small trees. They were paid 3d. a day. A force of 1000 woodcutters was ordered to be assembled at Chester to proceed to Rhuddlan,¹⁴¹

composed as follows: the sheriffs of Gloucester, Hereford, and Leicester & Warwick, were each to provide 100 woodcutters, the sheriffs of Salop & Stafford, Lancaster, and Nottingham & Derby 200 each, and the keeper of the Forest of Dean a further 100. Another force of 300 picked tree-fellers and charcoal-burners from Hereford and the Forest of Dean were ordered to Brecon for a renewed assault on the forests of west Wales.¹⁴²

General orders were issued for the passes to be cleared of trees and widened in west Wales,¹⁴³ and in central Wales between Montgomery and Llanbadarn and in Cyfeiliog.¹⁴⁴ These woods were to be felled, and rooted up to form clear passes a bowshot wide.

In December 1282, orders were given for another force of 800 woodcutters to be assembled at Chester for forest-clearance operations in north Wales (100 each from Wiltshire, Gloucester, Hereford and the Forest of Dean, 200 from Salop and Stafford, and 200 from Chester).¹⁴⁵ This campaign was pursued through the winter, in leafless forests. Bere Castle (Merioneth) was taken in April 1283, with 100 woodmen in the besieging forces, and more passes were cleared through the forests in that area.¹⁴⁶ At 'Botverry' (Bodfari, between Rhuddlan and Ruthin), 1300 men were engaged in felling in order to clear the passes in early May, 1283.¹⁴⁷

Again, this war was followed by another period of systematic felling of forests to clear passes. For example, in 1284 the monks of Strata Florida were commanded to fell the

groves (nemora) about roads in the woods (boscis) and to enlarge the passes in the county of Cardigan.¹⁴⁸ In the same year, the burgesses and others of Carmarthen were granted free common in the woods of Mahachan (Mallaen) and were permitted to fell and carry away underwood, oaks for timber, and other trees, without any let or hindrance, as a matter of deliberate policy to clear dense woods where robberies and murders were frequent.¹⁴⁹ These fellings were one of the causes of the rising of Rhys ap Maredudd, a native lord in the Vale of Towy, in 1287. This rising was suppressed by forces that included very large numbers of woodmen. For example, 200 wood-cutters from Chester were ordered to be assembled at Llanbadarn Fawr, and at the same time 400 wood-cutters (coupiatores) from the Forest of Dean were to be assembled, with their axes and other tools, at Monmouth, while 2000 diggers and woodcutters from Salop and Stafford were ordered to Brecon.¹⁵⁰ These were engaged on felling forests west of Brecon, in the Llywel area. Meanwhile, another body of woodmen, 600 strong at first, rising to 650 and then dropping to 300, was employed in cutting another path from Glamorgan to Brecknock via the Taff valley and Morlais.¹⁵¹

The felling policy was continued well after the 1287 rising was put down. Some authorities were apparently dilatory in carrying out royal felling instructions, and in May 1288 general instructions were issued to the justices of Chester, North Wales and West Wales, and to the marcher

lords: 'to cause ... the trees and underwood to be felled in such passes through every wood of his in those parts and to cause the passes to be enlarged and widened in the said woods without any further delay, wherever this shall be necessary in the said woods'.¹⁵² A phase of intensive forest clearance shown by the pollen record in west-central Wales is attributed to these military fellings in the late 13th century.¹⁵³

Even in the last Welsh rising against Edward I, in 1294-5, felling of forests still formed a vital part of military strategy, as recorded in a letter to the king, where the writer was 'in a wood which is called Ketthlieconhan'. (?Gellicynan; site unidentified), reputedly the strongest place in the whole of Ardudwy, being 'lodged therein to cut down the wood'.¹⁵⁴

Apart from the forest clearances, the other major element in the Norman military forest policy was the introduction of an organized logging industry to provide timber for the building and repair of castles. The 'king's works in Wales', i.e. the castle-building, represented operations on a scale never before seen in Wales. Initially, much of the timber used for the castles came from assortments shipped in from England, but as soon as local organization could be established, Welsh forests were selectively logged for the desired assortments. These ranged from small materials such as poles, shingles and laths, to various sizes of boards, and the largest pieces, i.e. great joists and beams, some over 30 ft.

long and $1\frac{1}{2}$ ft. square.

The Welsh forests had supplied timber for castle-building in the Isle of Man in 1102,¹⁵⁵ and Abbot Faritius (1100-1135) brought the beams and rafters for the rebuilding of Abingdon abbey from the Welsh border by six ox-wains.¹⁵⁶ The timber (meremium) used in major building works in Wales was rarely specified as regards species, but in most places it was undoubtedly and exclusively oak, the commonest and often the only timber tree species available. In the native beech area of south-east Wales, beech was used occasionally as well as, or perhaps even in preference to, oak. At Llangibby castle (Monmouthshire), beech trees were felled, topped and squared for sawing (fagis amputand' copand' et squarrandis ad sarrand') for castle repairs in 1286-7.¹⁵⁷

The castles represented enormous engineering works requiring large amounts of selected timber, not only for the initial building but also for regular replacement of decayed wood, this need persisting throughout the useful life of the castles, to the 16th century and later. The forests in the vicinity of the castles, and especially the forests convenient for transport of timber by water, were selectively logged for trees suitable for particular end-uses. Lengthwise sawing was avoided except for boards. Timbers were generally used in buildings in the form of a whole log roughly squared by adze. Scantlings were obtained from small oaks, and the larger beams from straight standard trees, presumably growing in natural or semi-natural forest. Selection was a skilled job, and specialists were entrusted with the job

of seeking out and marking suitable trees. Felling was by axe, marking irons (sigillo ferri ad signandum ligna vedenda)¹⁵⁸ were used to identify the felled timber for sale and to prevent misappropriation. Trees were trimmed, topped and usually squared at stump, before extraction. Sometimes the stems were sawn into boards at saw-pits in the forests. Large pieces of timber were extracted by horse or ox teams, and river floating in the form of loose logs or in rafts or shipment in small coastal vessels was employed wherever possible. For example, in 1185 some 24 ships were used to convey timber (maisremium) from the king's woods at Striguil (Chepstow) for work at Kenfig castle in Glamorgan,¹⁵⁹ and there are many references to the coastal shipping of wood and timber for work on castles in north Wales, e.g. Caernarfon, Beaumaris and Harlech. The ships were of various sizes and were drawn from very varied sources; they carried loads of timber expressed in terms of tuns of wine, viz. tonnages of 8, 12, 14, 18½, 24, 40, 60, 80 and 150 tons.¹⁶⁰

The forest operations associated with castle-building were similar for all the major castles in Wales, but only fragmentary records survive. A few examples, from south and from north Wales, will suffice to illustrate the types of materials produced from the forests.

For Carmarthen castle, carpenters were paid for making joists and other timbers 'in the wood', and in the 13th and subsequent centuries much timber was bought from local forests, including the forest of Glyncothi, e.g. laths, small boards,

large boards (some 20 ft. long), wallplates, and large squared timber.¹⁶¹ Later on, the Carmarthen Castle accounts for 1430-2 reveal substantial expenditure on timber for the repair of the King's barge, the assortments bought and carried including long 'shipboards', 'half-boards', logs for rollers and for making treenails, a prow beam, 'wrangs' (deck timbers), and trees for making 'hodyngis' (stern planks), 'carlyngs' (short timbers running between the deckbeams), 'revesynges' (?), 'knevis' (knees), a 'folocke' etc.¹⁶²

At Caernarfon, timber was first imported from Cheshire and Lancashire but in 1295 various assortments were brought from woods in the Conway valley, and in 1321 these woods supplied large numbers of great joists (gistae) each 18 royal feet long, $1\frac{1}{2}$ ft. wide and 2 ft. thick, and also large beams (wyures) 32 ft. long by $1\frac{1}{2}$ ft. square.¹⁶³ It is significant that this timber had to be transported some 30 miles to the castle and that the transport was by water. Throughout its life, Caernarfon castle was maintained and repaired with timber felled in the Conway valley and in Cheshire. In the 16th century, small rods and fuelwood for Caernarfon were cut at Rhedynogfelen (near Llanwnda) and larger timber in the Conway valley.¹⁶⁴

Flint castle was regularly supplied with forest products from the wood of Ewloe, as shown e.g. by the Chamberlain's Accounts for 1302-3 and 1303-4,¹⁶⁵ the items furnished including 'legges' (wooden ties), great and thick planks, boards, various roundwood assortments called

'spurlaces', 'steppes', 'courbes', and 'soles' (30 ft. in length), great posts, beams, 'sperra' (spars), and laths. The primary conversion of the roundwood, including squaring by adzing (scapulo), and pit-sawing to boards, was regularly carried out in the wood.

Even as late as the 16th century, the castles in north Wales were requiring heavy expenditure on timber, as evidenced by the following selected items from the accounts for Harlech Castle for 1539-40:

20 trees at 8p. each	13s. 4d.
felling these trees and 2 great somers (beams)	3s. 4d.
carriage of 18 of these trees	13s. 6d.
carriage of 2 great somers, 22d. and 5s.	6s. 10d.
carriage of sawn boards of 3 trees from the wood	1s. 8d.
22 'oks' (oaks)	22s. 8d.
felling these trees	4s. 8d.
2 carpenters for 2 days choosing this timber	12d.
5 men working 10 days on this timber	4s. 10d.
carriage of 2 great trees from Dolgellau by water to Abermo	2s. 8d.

The details show that transport, especially land transport, was relatively expensive, costing more than the value of the standing timber.

2. Forests and Woods in Medieval Wales and their Utilization

The rules governing hunting and falconry, the value of the hounds and hawks, and the status of the chief huntsman and falconer as given in the Welsh Laws (cf. p.48) show the importance attached to hunting and game management in Wales. Much of the territory of the hunting grounds was still well wooded in the early Middle Ages. With the conquest of territories in eastern and southern Wales, the Marcher lords set up 'forests' in their lordships, with the appropriate organization, imitating the forests of the Norman kings in England. Afforestation (in this legal sense) involved the creation of 'forests', i.e. permanent hunting preserves with defined boundaries, under separate legal administration, the highly restrictive and oppressive 'forest law' administered by forest courts.¹⁶⁷

The forests were lands, partly but not necessarily woodlands, reserved for hunting, and they consisted of 'vert and venison'. Venison meant the game animals, and the gravest offences were those involving the game, especially the deer. Vert included all trees, coppices and vegetation forming the coverts and feeding grounds of the deer and other game. The main offences against vert were purpresture (enclosure of or encroachment upon land), waste (felling of trees), and assart (grubbing up and permanent clearance of woodland to form arable land).

The officers appointed for the administration of forests were the justice in eyre (justiciarius itinerans), verderers

(viridarii), regards (regardatores), foresters (forestarii), woodwards (woodwardii) and agistors (agistatores). The regards supervised the general work of the local executive officers. The foresters ranged the forest to protect the vert and venison, and made attachments and presentments in the case of offences. Woodward appeared at a comparatively late date, when the importance of the timber resources had increased relative to that of the game, and they performed miscellaneous duties relating to vert, such as marking for felling, superintending felling, etc. The agistors collected the grazing dues (agistments) and supervised livestock grazing in the forest.

The courts of the forest consisted of the Eyre of the Forest, the Swainmote, and the Woodmote. The Woodmote was a court of preliminary enquiry. The Swainmote tried the cases committed from the Woodmote, the verderers being the judges, and freeholders of the forest forming the jury. The Eyre of the Forest was the high court for the administration of the forest law. The forest courts had jurisdiction over the territory and inhabitants of the forest, and replaced the ordinary courts. The courts dealt with all matters concerning the forest, viz. all infringements of the forest law, the collection of rents and customary dues, arrangements for agistment and pannage, collection of fines and tolls, etc.

In England, in the 11th and 12th centuries afforestation had been extensive and the administration of the forest law very severe, with penalties of mutilation and death for

offences against game. Several clauses of Magna Charta (1215) related specifically to the forests, and gave relief from some of the most oppressive of the forest laws. In 1225 the Charta Forestae was enacted, disafforesting many lands and substituting fines for more severe punishments. Its 16 sections dealt with:

1. Certain grounds shall be disafforested.
2. Who are bound to the summons of the forest.
3. Certain woods made forest shall be disafforested.
4. No purpresture, waste or assarts shall be made in forests.
5. When rangers shall make their range in the forest.
6. Lawing of dogs in forests.
7. In what cases gatherings shall be made in forests, and the appointment of foresters.
8. Where swainmotes shall be kept, and who shall repair to them.
9. Who may take agistment and pawnage in forests.
10. The punishment for killing the King's deer.
11. A nobleman may kill a deer in the forest.
- 12 & 13. How a freeman may use his land in the forest.
14. Who may take chiminage or toll in a forest, for what cause, and how much.
15. A pardon of outlaws of trespass within the forest.
16. How plea of the forest shall be holden..

In 1306 an Ordinatio Forestae was passed containing six short sections:

1. How offences done in the forest shall be presented.
2. An officer dying, or being absent, another shall be put in his place.
3. No forester shall be put in assizes or juries out of the forest.
4. The punishment of officers surcharging the forest.
5. Grounds disafforested.
6. Common in the forest.

The Magna Charta and the Charta Forestae were confirmed repeatedly through the 14th century. English statutes did not automatically apply in the Crown lands of Wales, where government was sufficiently flexible to recognize various native rights and usages, though English law was administered by English methods where the vital interests of the Crown were involved, especially in the preservation of law and order. The establishment of special forest areas was foreign to Wales, and was resented by the people, because it involved the suspension of the common law within the area of the forest, and restrictions on or complete withdrawal of substantial areas of the common pasture. People dwelling in or near a forest were largely at the mercy of the forest officers who were vested with arbitrary powers under the forest law, and who frequently abused these powers by petty tyranny and extortion.

The first of the Norman hunting forests in Wales were established in the late 11th century by the marcher lords, and are referred to in the Domesday Book. For example, the

Earl of Chester's forest at Soughton (Flintshire) was 10 leagues long and 3 leagues wide (cf. p.54). Many more such forests were created in the 12th and 13th centuries, the largest of which was the Great Forest (Fforest Fawr) of Brecknock. Bernard de Newmarch, after his conquest of Brecon late in the 11th century, reserved to himself the large unenclosed tracts in the south-west of the lordship as 'forest', a great upland game reserve covering over 50 square miles of country, most of it well over 800 ft. above sea level. By the 13th century part of this Forest had been leased off as a separate unit, the Little Forest; the rest was known as the Great Forest, and comprised moorland and scrub waste, with extensive wooded areas, especially in the valleys. The Brecon lordship, including the Forest, was taken over by the Crown in 1521 and remained in Crown possession until 1815, when it was still 40,000 acres in extent. The history of the Great Forest of Brecknock has been detailed by Lloyd and Rees.¹⁶⁸

The location and often the name of many of these hunting forests are known from surviving contemporary manuscripts, and have been mapped for the southern part of Wales and the Marches in the first half of the 14th century.¹⁶⁹ The locations of over 100 forests are shown on these maps, as well as nearly 50 woods, but the actual boundaries and extent of the forests and the woods are known even approximately in only a very few cases.* The maps also show the locations of over 100 commons and 21 deer parks. These

*See Appendix 2 for named woods and forests.

commons were often largely woodland or scrubland at this time (cf. pp.83-4). Parks were deer enclosures, surrounded by a strong and high pale or palisade and sometimes also with a ditch. The pale itself was generally made of high-quality cleft oak (see p.89), and the area emparked contained a substantial proportion of woodland and thicket to provide shelter for the deer (see p.92). The significance of parks as private wood-pasture in England has been discussed by Rackham.¹⁷⁰

Research since the publication of Rees' maps has revealed the existence of more medieval woods in south Wales. A number of the hunting forests established in north Wales have also been identified, as well as the names and often the locations of many woods, parks and commons. Fig. 5 maps all the forests and some of the major woods known to exist in the 13th and 14th centuries.

In many cases the names of the forests shown in Fig. 5 are not known, and the distribution clearly reflects the surviving records of the period. Areas with few forests marked, e.g. mid Wales, were certainly still well-wooded in this period.

The largest and most famous of the forests of north Wales was the Forest of Snowdon, which lay mainly in Caernarvonshire and perhaps also part of north Merioneth, though the date of its establishment, its boundaries and extent are uncertain. The forest persisted as a legal entity until the 17th century, the forest laws being repealed in 1640.¹⁷¹

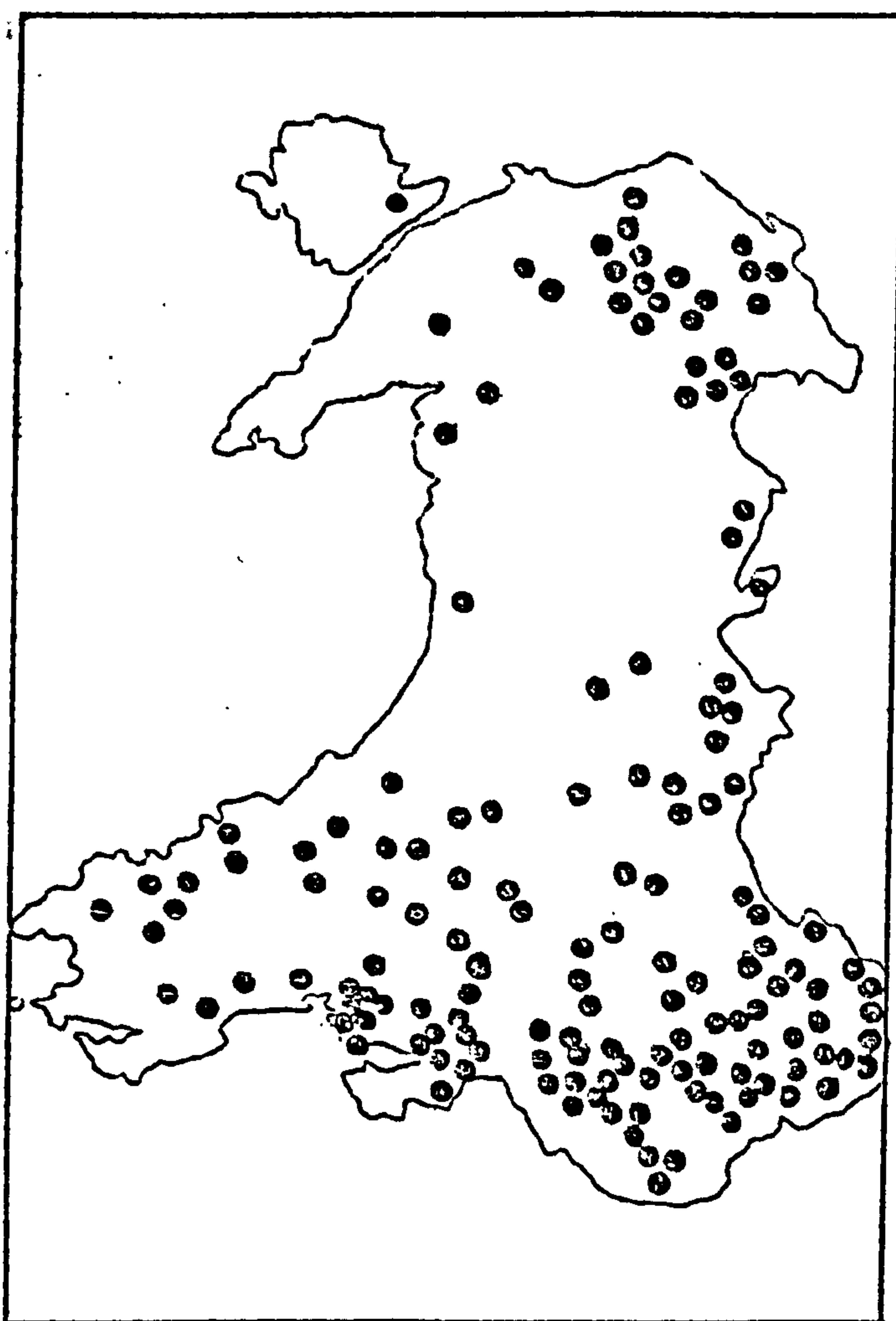


Fig. 5. Map of all known forests and some important woods in the 13th and 14th centuries. Each dot represents one forest or major wood, regardless of its actual area.

The administration of some of the forests in Wales is known in detail, e.g. for the Forest of Glyncothi, comprising the whole of the Upper Cothi valley in north Carmarthenshire, which was withdrawn from the commote of Mabelfew and given over to the castle of Carmarthen; Pennant forest, nearby, was also created at the same time. The names, periods of

office and brief details of many of the foresters, deputy foresters, sub-foresters and beadles of Glyncothi and Pennant have been listed, from Einion ap Trahaiarn and Cadwgan ab Ieuan in 1301-2 to Hywel ap Guto in 1533-4.¹⁷² The foresters held the forests in one of two ways, either farming (i.e. renting) them from the lord, or receiving a fixed stipend, sometimes supplemented by fees from various sources according to local custom.¹⁷³ In the lordship of Ruthin, the foresters and parkers were initially Anglo-Norman, but they were succeeded by Welshmen; the acreage of woodland in the lordship is not known, but the 33 pieces of seigneurial demesne throughout the lordship were protected by at least 10 foresters and 7 parkers.¹⁷⁴

After the Edwardian settlement of north Wales and the establishment of royal forests, offences of the vert were punished in the hundred court but always formed a class by themselves. Examples of vert offences are given from the court rolls of the lordship of Ruthin,¹⁷⁵ e.g. at the Court of Llannerch, 12 Aug. 1295:

<u>Offence</u>	<u>Fine</u>
cutting green wood in the forest	6d.
cattle feeding in the forest	6d.
cutting one tree	6d.
carrying away old wood	6d.
cutting down boughs of oak for oxen	12d.
cutting rods in the forest	2d.
cutting and carrying away green wood	2s.

Details of many forest offences are also given in the proceedings of the small hundred court of the commote of

Ardudwy (Merioneth) for the period October 1325 to September 1326.¹⁷⁶ The offences mainly concerned the unauthorized felling and removal of loads of underwood (subboscus) and rods (virgarum), but tree species were often also specified, viz. unam quercum iuvenem (one young oak), unam corulum viridem (one green hazel), duos magnos ramos de duabus quercubus (two large branches from two oak trees), unam fraxinum et tres corulos (one ash and three hazels), and unam arborem pomorum silvestrium (one crabapple tree). The court records therefore indicate the composition of the local forest at the period.

Common woods, and commons that were largely or partly woodland, were indispensable to every community. The common woods yielded wood for the repair of buildings (housebote), agricultural implements (ploughbote), and hedges (haybote); also, fuelwood, grazing for livestock, mast for fattening pigs in the autumn, honey and wax from wild bees, and miscellaneous products such as bracken and litter. The lord had a certain amount of control over the common woods, the degree of control varying locally. The conflicting interests and abuse of the commons and common woods over the centuries led to degradation of the woodlands, and also to encroachments. A good example of the pressure on the common woods can be seen from the Caernarvon Court Rolls for 1361-1402.¹⁷⁷ On 28 March 1368, 35 different people were amerced (fined) for various felling offences in the common wood: 19 men were fined small sums ranging from 6d. to 12d.

(in one case 5s.) for cutting fuelwood in the common wood, and 16 men were fined sums ranging from 3d. to 10s. for felling specified numbers of trees. The amercements were at a standard rate of 1d. per tree, except in the case of the worst offender, Laurence de Wynston, who felled 100 trees and was fined 10s. The total number of trees felled in these offences was 449. On 10 September 1375, seven people were amerced 12s. for felling trees valued at 5s. in the common wood, and many other similar offences, by men and women, are recorded in the rolls. Despite depredations of this kind over a long period, some common woods have persisted to the present day. One rare example of a substantial area of woodland still subject to common rights is the common wood of Allt-y-rhiw, Coity Wallia, which covers 124 acres in the Ogwr valley (Glamorgan). Tansley described this wood in the 1920s,¹⁷⁸ and his description still applies today (April 1978), viz. virtually pure sessile oak, uneven-aged and with a wide range of diameters, but only 15-30 ft. high. Natural regeneration is present, but the older stems are twisted, bushy and mis-shapen, as a result of frequent coppicing and/or lopping.

Pleas and petitions concerning disputes over woodland were numerous in all parts of Wales throughout the Middle Ages. For example, in 1279 a dispute over felling timber in the wood of Coedgaer between Llywelyn Vychan, a Welsh baron, and the King's men of Oswestry resulted in bloodshed.¹⁷⁹ Three other examples of abuse involved: a complaint by the burgesses of Overton (Flintshire) in 1309 regarding the

almost complete destruction of 500 acres of wood;¹⁸⁰ the
 ejection of William de Donecastre from 87 acres of land
 in the park of Segroit (Denbighshire) carrying oak and
 underwood valued at £70 in 1327;¹⁸¹ and the felling of 3000
 green oaks in the woods of Coydrath and Rodewode
 (Pembrkeshire), worth 200 marks*, in 1386 and the
 decay of the underwood there through lack of custody
 and enclosure.¹⁸² Indeed, disputes over woodland were
 frequent enough to make it worth the medieval lawyer's
 while to have a model plaint of cutting timber in his
 precedent book:

'To wit: the present David, son of Llywelyn,
 is preferring lawful plaint to the lord of this
 session...against the present Morgan Vychan, son
 of Morgan the Black, who is, in the situation of
 a defending party, bound to answer my plaint. The
 matter and cause of my plaint is, to wit: that the
 present Morgan came within a certain day, the
 Tuesday next after the feast day of St. Dewi last
 past within this year, to where I was owner of
 wood, within the maenor of Gwinvai [Gwynfe,
 Carmarthenshire] ... And that the present Morgan
 came with a fuel hatchet of steel and iron, and
 did cut two branching oaks, that would have been
 worth six score curt pence, each of them; and
 twelve white hazels, that would be worth fifteen
 curt pence, each of them; and six black thorns,
 that would be worth seven pence halfpenny, each
 of them; and nine willows, and ash, and alder,
 that would be worth sixpence of the curt pennies,

*one mark = $\frac{2}{3}$ of £1, viz. 13s. 4d.

each of them. And that the present Morgan is holding that by covert and detention... causing injury to a person, or to his property, without doing either right or peace therefor: the which injury has been shown to such as it was right to show it, the land-borderers, and to the officers of the lord. And further, that the present Morgan is a person competent in law to do right, and to receive it; and that the present David is a person competent in law to do right, and to receive it, if there be who shall require it. Application by David to Morgan, to know if he would do right, before plaint; and a negative was every time, on the part of the said Morgan: and on account of the negative by Morgan is my plaint. Requiring a timely answer.¹⁸³

Strict supervision of forests by foresters and woodwards, multiple-use of forests, and complete utilization of forest products were the main features of the peasant economy of the forests in medieval Wales. The vital importance of the forests and woods in Wales was first outlined by Lewis¹⁸⁴ and later and in more detail for South Wales by Rees.¹⁸⁵ This importance of the forest resource and forest products is stressed in the wording of countless pleas and petitions through the 13th and 14th centuries, e.g. a petition to the King in the first decade of the 14th century by the men of Hopedale and Kinnerton (Flintshire), complaining that 'the Earl of Warenne has not allowed them to take, or make use of, anything in their own woods, except by view of foresters, whereas they had been wont to do this at their will, and, moreover, the greater part of their sustenance is derived from the woods'.¹⁸⁶

Initially, the forests were primarily hunting preserves, and management was directed to game conservation, e.g. deer were fed with hay during winter.¹⁸⁷ However, by the 14th century the forests were no longer regarded primarily as game preserves in many parts of Wales, though in the border lordships, especially Wigmore and Strigoil, the preserves were better cared for and hunting was carried on to a greater extent than elsewhere. With the decline of hunting the other issues of the forest, i.e. the other forest functions and products, became of increasing importance, and the forest was now regarded as a revenue-producing part of the lordship. Apart from the game animals, the main forest products (not necessarily in order of importance) were: large timber and logging debris; underwood; bark; windthrown trees and dead wood; charcoal; tree foliage; fruits, berries and nuts; mast; herbage; honey and wax; hawks; and wood ashes and dyestuffs. Examples of each of these products will be discussed briefly below. Sometimes coal and metal ores were considered as issues of the forest, and also materials such as peat, bracken, litter, furze, broom, reeds and rushes, but these items will not be considered here.

Large Timber and Logging Debris.

The forests provided large and small assortments of hardwood timber for a variety of end-uses. The main timber species was oak, but elm, ash and (in south-east Wales) beech were also important. Large timbers were required for the major building works of medieval Wales, i.e. castles, bridges,

mills, fishing weirs, halls, churches, houses, and the enclosure of deer parks, and also for making ships, carts, ploughs, furniture and a host of smaller items and utensils. Large stems suitable for the particular purpose were sought out and felled selectively in the forest, i.e. an informal irregular selection system of management. This, combined with repeated cutting of underwood on a coppice rotation (see below) would have tended to result in coppice with some standards, but in many areas simple coppice was the general rule. Details of the use of timber, almost exclusively oak, for castle building, repair and maintenance are outlined on pp.70-4. Some fine timber halls, after the English fashion, were erected in the early 14th century in Wales, e.g. at Henblas (Llandderfel, Merioneth) and Penarth Fawr (Llanarmon, Caernarvonshire) and illustrate the skilled use of large amounts of timber.¹⁸⁸ Water-driven corn mills were vital in the life of each community, and the building and maintenance of the mills, wheels and sluices involved the selection of particular species for particular end-uses. For example, in 1481/2 the repairs to the mills of Pembroke and Castle Martin involved '1 asshe to make ladles for the wheels' and '1 elme tree to make chinkes'. Wood was also imported, for the same mills required a dozen Irish boards for 'chugkyng wegges' and 5 English boards.¹⁸⁹ The carriage of timber represented a considerable problem where river floating was not feasible, and obligatory services for the carrying of large timber and stones for the mill were often owed by the local population to the lord. Such

carrying services are described e.g. in the Extent of Anglesey (1352)¹⁹⁰ and in the lands of the Bishop of St. Davids (1326).¹⁹¹

The carrying services were probably survivals and extensions of Welsh tribal customs and generally related to large timber (grossu meremium), e.g. timber that could not be drawn by one horse, but also sometimes to boards, firewood and charcoal.

In later periods, these carrying services were often commuted to the payment of cash in lieu. Enclosure of deer parks required large amounts of good-quality timber to make and maintain a deer-proof perimeter fence. Emparking was generally done with a pale, a palisade of cleft oak stakes, as for example at the park of Thluydcote (Llwydcoed, Flintshire) which in 1347-8 was enclosed with 'palings from the timber of the same park, 559 perches at 6d. per perch'.¹⁹² Wood was required for the fishing weirs that were built on all the rivers of Wales, e.g. complaints were made in 1340 that the weir of Cilgerran on the river Teifi prevented the transport of timber and other necessities to the town and castle of Cardigan, and also prevented fish going upstream to the King's weirs of Llechryd and Cenarth.¹⁹³ Slash, i.e. branch-wood and other logging debris, was never wasted as it represented a valuable additional source of timber and fuelwood. For example, when 8 oak trees were felled in 1351-2 for the building of a bridge over the river Dee, the branches of the trees were sold separately for 7s.¹⁹⁴ As part of the policy to obtain revenue from controlled exploitation of forest resources, licences were issued to woodworkers such as carpenters and turners to work for specified periods in

the forest, making various wooden utensils for sale. The articles made were usually domestic and agricultural items such as furniture, chests or ploughs; barrels, casks, buckets, pails, tubs, and vats made from oak and hooped with ash or willow; and bowls and dishes (disci) turned from sycamore, beech or birch. These utensils were sometimes given the general name of woodasken or wodeway. For example, the accounts of Senghennydd for 1281 record revenue from men working on dead wood (operariis operantibus super mortuum boscum) in the forest, from men making chests (cistae) in the forest, and from a wood-turner (tornatore).¹⁹⁵ Several other examples of income from this source in various parts of south Wales are listed by Rees.¹⁹⁶

Underwood. Most of the native broadleaved tree and shrub species of Wales are capable of regenerating vigorously by coppice sprouts, and it was the repeated cutting of the underwood that yielded the regular supply of produce on which the population depended. The underwood yielded fuel, small roundwood assortments such as poles, posts and rods, material for the repair of fences and hedges and for making numerous smaller domestic and agricultural utensils, as well as much of the raw material for the manufacture of charcoal for smelting or lime-burning. Thus, the underwood, cut regularly on a coppice rotation, governed the annual value of the wood of the forest. Dense high forest, i.e. woods consisting entirely or mainly of standard trees with little or no underwood, was of no annual value as regards wood. This is clearly shown by the example of the wood of Coydragheyn in Postu

(Postyn) in the Lordship of Denbigh in 1334.¹⁹⁷ This wood contained 158 acres 1½ roods, but the lord received no yearly profit because of the density of the great oaks (propter spissitudinem grossarum quercuum) and because all the tenants claimed common of pasture there. The principles of coppice management with protection of the stools to ensure regrowth had been long established. The length of the coppice rotation depended on site, tree species and presumably the pressure of demand, the usual rotation being about 10-14 years. An example of a coppice rotation is described for a wood in the Lordship of Denbigh, in the commote of Rhos Isdulas:

unus boscus qui vocatur Pendinas vestitus debili
subbosco qui continet xxxiiij acr. iij rod. qui poterit
amputari quolibet duodecimo anno et tunc valebit
acra iiij s. Et sic si subboscos proporcionetur
in xij partes equales valebit per annum xjs. iij d.¹⁹⁸

(a wood called Pendinas having a sparse underwood which contains 33 acres 3 roods which can be cut every 12 years and then is worth 4s. per acre. And if the underwood is divided into 12 equal parts it is worth 11s. 3d. per annum). The annual value of the pasture in Pendinas wood was 2s. 9d., making a total annual value of 14s. The need to cut regularly to maintain the supply of the desired small assortments was recognized. The wood of Rusty (Hopedale, Flintshire) was stated in 1347 to be beginning to spoil because it had not been cut in due season.¹⁹⁹ The chamberlain was instructed to cut, and to enclose the felled areas to prevent livestock

from entering and destroying the young growth. A few years later, in 1351, a coppicing experiment to determine optimum stool height (the first recorded forestry experiment in Wales) was tried in Hopedale: a part of the wood was to be 'cut down to the ground, and a part not so far, so that it may be possible to see which part grows best'.²⁰⁰ The combination of coppice management of underwood with pasture and game can be seen from the following tabular statement of land-use and financial returns for three parks in the commote of Rhufoniog Isaled in the Lordship of Denbigh in 1334.²⁰¹

Table 8. Land-use and yield in three medieval parks.

	Little Park (Parvus Parcus)	Galghull' Park	Moillewyk' Park
Enclosure	ditch + paling	ditch + paling	paling
Total area	264 acres	62 acres	442 acres
Launds (lande) i.e. pasture	227 "	37 "	162 "
Dense thorn underwood	7 "	20 "	} 280 "
Alderwood	30 "	4½ "	
Coppice rotation	12 years	12 years	12 years
Coppice value/acre	8s.	8s.	8s.
Coppice value/acre/annum	8d.	8d.	8d.
Pasture value/acre/annum	12d.	12d.	12d.

The total area coppiced in these three parks was $28\frac{1}{2}$ acres per annum which, at 8s./year, gave an annual return of £11 8s.; the pasture, if not occupied by game animals (si non occupetur cum feris), amounted to 426 acres at 12d./acre = £21 6s. The total annual return was therefore £32 14s. from coppice and pasture.

Bark. Oak bark was harvested from felled trees and used for tanning leather. In the mid 13th century the monks of the Cistercian abbey of Tintern were allowed to buy all the bark of all the lower forest of Went (Wentwood Forest) for 2d. per load, for use in the monks' tannery.²⁰² In 1272 the Forester of Wentwood included in his receipts £4 16s. 4½ d. for bark and thatch.²⁰³ In north Wales, bark from felled trees made a regular contribution to the revenue from the woods of Baghegere and le Rust and the park of Loytkoyt (Llwydcoed) in Hope and Hopedale, Flintshire, in the mid 14th century.²⁰⁴

Windthrown Trees and Dead Wood. Dead wood, windthrown trees and debris were carefully harvested in forests in all parts of Wales. This category of material formed a regular source of wood that could be used without the labour of felling and without damage to the forest. For example, in Flintshire the Ministers Accounts in the 14th century show that windthrown trees, mainly oak and sometimes described as old trees, in the woods of Rusty, Baghegre and Ewloe and in the park of Thloetcoet (Llwydcoed) were sold every year: good stems were sold as timber; the branches, twigs and stumps of windthrown trees were generally used as fuel or for making charcoal, and even the roots of windthrown trees were utilized.²⁰⁵

Charcoal. The making of charcoal to supply the lord's castle, to fuel the local metal-smelting enterprises (especially lead and iron), and to burn lime, was important in certain parts of Wales. Large numbers of professional charcoal-burners (carbonatores or carbonarii) were specifically recruited for tree-felling in military campaigns (see p.64), and in times of

peace the amounts of charcoal produced were sometimes very considerable. In 1284 the burgesses of Flint were granted all the necessities for mining and smelting lead ore from the wood and underwood in the woods in the Northop area and as far as Ewloe;²⁰⁶ in the following century Les Leis et Custumes de la Minere (Laws and Customs of the Mines) allowed the lead-miners all manner of wood (toute manere de merym) for use in the mines, this including building timber, pitwood, and wood for making charcoal;²⁰⁷ branchwood and underwood were regularly used for lead smelting, the lord receiving a sixth of the lead smelted with his underwood.²⁰⁸ In the iron-smelting area of Gwent, large amounts of charcoal were made and sold, e.g. at Machen Forest in 1316, 830 dozen and 9 loads of charcoal were made and sold at 6d. a dozen to give £20. 15s. 4¹/₂d.²⁰⁹ In 1330 sales of charcoal in the forest and park of Trelech were:

£56 19s. 9d. charcoal sold at Penallt

£30 13s. 9d. charcoal sold in the forest of Trelech

£43 8s. 0d. charcoal sold by the charcoal burner

£ 7 18s. 6d. " " " " " "

The wages of the supervisor of the charcoal burning, 19 weeks, and two assistants (carbonatores) were 21s. 2d., plus some of the waste wood. The weekly accounts of sales of charcoal at Trelech show receipts in certain weeks as high as 6⁴/₈s.²¹⁰ The charcoal was measured in hodds, loads and dozens (1 dozen = 12 loads; 1 load = 4 hodds). Iron forges were operated on charcoal made from the windthrown material and underwood in the forest of Rusty and other woods in Hopedale (Flintshire) in the mid 14th century.²¹¹ (For details of the charcoal industry in later centuries, see pp. 148-162).

Tree Foliage. The lopping of elm to provide fodder for livestock has been suggested as a cause of elm decline in prehistoric times (cf. p. 18-9), and the cutting of leafy branches to provide winter fodder for cattle was apparently practised in places in Wales, though it is not possible to assess how widespread the practice was or how long it persisted. In 1295, Anian Cryyth was fined 12d. at the Court of Llannerch in the lordship of Ruthin for cutting down boughs of oak for his oxen (decimavit ramos querçm ad boves suos) without licence.²¹² Several other people were fined on the same occasion for cutting and carrying away green wood (boscū viridu), though the purpose was not specified.

Fruits, Berries and Nuts. Forest fruits, berries and nuts were doubtless collected in season for human consumption, but such records as survive are ambiguous and may sometimes refer to mast collected for or eaten by swine. In Bromfield and Yale (Flintshire), a levy of 1½d. or 1d. a year was made for the right to gather nuts in 1315,²¹³ and in the 200-acre forest of Lloydarth (Pembrokeshire) the fruit, both acorns and nuts (glandibus et nucibus), was worth annually 2s. in 1326.²¹⁴ The issues of the forest of Melenyth (Malienydd, Radnorshire) for 1356-7 recorded no revenue from nuts because the wood was let to the Abbot of Cwmhir.²¹⁵ In the lordship of Abergavenny, 15 trugs (i.e. baskets) of nuts were sold in 1256/7.²¹⁶

Mast. Acorns, hazel nuts and beechmast provided the means of fattening swine in the forest in the autumn, i.e. pannage. Income from pannage was one of the most widespread and important, though irregular, sources of revenue from the forest.²¹⁷ Pannage

dues were of two kinds, viz. payments by freemen who chose to feed their swine in the forest, and payments levied on the bondmen. In the more anglicized manors of south and east Wales, pannage payment was required at a fixed sum, e.g. 1d. per pig, but in west Wales the Welsh system involved assessing the pannage payment in kind, i.e. one pig from every tenant feeding more than a certain fixed number of swine in the woods, though pannage was free for pigs below the fixed number. For example, in the commote of Catheiniog (Cantref Mawr) in 1305-6 the pannage due was specified as 'each man who has four pigs or more in the said forests or woods rendering one pig to be chosen in accordance with the custom in those parts, and if he have less than four he shall pay nothing'.²¹⁸ Under the Welsh system the pannage dues were assessed and collected at a swine-mote, i.e. an appointed place to which all persons having swine in the forest were obliged to bring their pigs at the end of the pannage season. Non-attendance at the mote, or failure to produce the swine, involved a fine. The pigs selected were sold on the spot, sent to a market, or killed for the castle larder. Pannage revenue obviously depended on the abundance and frequency of mast years, and oak mast years are irregular in Wales. For example in 1328 pannage of the woods of Eulowe and Baghegre yielded 12s. and 30s. respectively, but in 1335-6 nothing 'because there were no acorns there this year'.²¹⁹ (cf. also pp. 118-9). Pannage of pigs in oakwoods persisted in places until the 20th century, e.g. in the common wood at Allt-y-rhiw (Glamorgan).²²⁰

Herbage. Pasture of livestock was one of the most important of all the functions of forests and woods, and indeed remained

so until comparatively recently. The practice of grazing and the sale of pasture were termed agistment, the grazing dues too being called agistments. In his private woods and parks, the lord could dispose of pasture at will, but in forests the long-standing communal rights and claims were frequently so strong as to compel compromise, and were long a source of dispute. Rees cites several records showing the grazing rights of the free tenants in terms of numbers of livestock, i.e. cattle, oxen, sheep, horses and swine, and discusses some of the complexities and local variations in the practice of agistment.²²¹ Where the lord was in full possession of the pasture it was customary to sell rights of agistment for the year, usually for a cash sum, though in the forest of Cantref Selyf the grazing assessment was paid in capons and hens. The 'farming' (leasing) of forests was mainly responsible for the loss of common rights, and subsequently involved much dispute and litigation. Two examples of agistment in west Wales in 1326 can be cited from the Black Book of St. Davids for the forests of Atpar (south Cardiganshire) and Lloydarth (north Pembrokeshire).²²² At Atpar the Bishop of St. Davids had a forest of 40 acres 'and each acre with the fruit and herbage is worth 3d. [per annum]'. And if there was no agistment in the forest the Lord would be able to keep there 12 great beasts, 100 sheep, and 24 pigs'. The forest of Lloydarth was 300 acres 'and they are able to keep there 20 mares in foal, 40 great beasts and 200 sheep, and the grazing of each great beast is worth

1d. and of every 10 sheep 1d. [per annum] '. Forest grazing obviously was responsible for the degradation of woodland, and the amount and quality of the herbage improved as the condition of the woods deteriorated. Examples of combined coppice and pasture management in fenced deer parks in the lordship of Denbigh have already been described (see p. 92).

Honey and Wax. Forest beekeeping in natural holes or holes artificially made in standing trees, or in hollowed out logs hung up in the forest, was common in Eastern Europe and may also have been practised in Wales.²²³ Certainly, honey and wax from wild bees' nests and from hives kept in the forest were important sources of forest revenue, and the amounts involved were sometimes large. The accounts and inventory for 1298-1300 showed that the Castles of Llanbadarn, Dinevor, Dryslwyn and Emlyn had 11 casks 168 gallons of honey; In 1303-4 the proceeds of a hive in the forest of Glyncothi yielded two gallons of honey, worth 12d.²²⁴ In 1349-50, two gallons of honey of woodland bees in the Park of Thloetcoed (Llwydcoed), at Hope, Flintshire, were valued at 1s. 8d.²²⁵ The accounts of the castle and lordship of Llanstephan (Carmarthenshire) for 1410-11 record 13p. received for forest honey,²²⁶ but by 1500-1 the accounts state 'of forest honey and wax there this year, nothing, because there is no wood (silva) there, neither are the trees grown where such honey and wax may be had'.²²⁷ Hollow trees containing bees' nests were specially valued items in the Welsh Laws (cf. p. 49).

Hawks. The provision of hawks for falconry was an important function of the forest, and nests were guarded until the young hawks could be taken. The presence of hawks' nests in forests or woods was often specified in the Domesday survey (cf. p. 54), and the Welsh Laws gave the value of a hawk's eyrie as £1. The Welsh forests were a good source of hawks and many were exported, e.g. 2 falcons and 7 sparrow-hawks from eyries in Wales were taken from Carmarthen to Dover in June 1305,²²⁸ and in 1484 a warrant was issued to take at reasonable price 'such goshawks, tarcells, fawcons, laneretts and other hawks as can begotten within the principality of Wales... as shall be necessary for the king's disport'.²²⁹

Wood Ashes and Dyestuffs. Wood ashes, rich in potash, were used in soap-making in the Middle Ages,²³⁰ and dyer's ashes (cineres tinctorum) sold by the forester formed another minor source of revenue.²³¹ Dye woods were sought in Wyeswood and Bernardswood (Gwent) by the monks of Tintern in 1387-8.²³²

Accordingly, the main categories of revenue came from: the sales of wood and other materials; pannage payments for the feeding of swine in the forests; agistments or grazing fees for depasturing livestock on forest herbage; amercements (fines) for various forest offences such as felling without a licence; tolls exacted on strangers passing through the forest; confiscation of stray livestock; and licences issued to woodworkers to work in the forest. All these various sources of revenue, their importance and varying local procedures have been discussed in some detail by Rees.²³³

The rights of tenants to take firewood (firebote), and timber for the repair of buildings (housebote), hedges and fences (haybote or hedgebote), agricultural implements (ploughbote), and carts (cartbote) were known as rights of estovers. They varied locally but often included dead wood as well as green wood and usually applied on condition that none of the wood be sold or given to anyone having no rights of common. The rights to estovers were frequently included in the earliest town charters, and were repeated or modified when the charters were renewed over the centuries. For example, in the charter to the burgesses of Ruthin in the 1280s, the lord granted them housebote et heybote in bosco meo qui vocatur Garthllegva (housebote and hedgebote in my wood called Garthlegfa), as well as common pasture for beasts and permission to take mortum boscum sine visu forestariorum meorum (dead wood without the supervision of my foresters)²³⁴. Two centuries later, in 1496, the charter of the Borough of Ruthin allowed the burgess to 'have and take without the supervision of my foresters housebote and haybote in my wood which is called Garthlegfa and have common pasture in the same wood for their animals until I make them reasonable provision in a more suitable place; and that they shall have and take dead wood without the supervision of my foresters in my foreign woods... and that when there is mast in my woods they shall give for their pigs feeding in the same the tenth pig by name of pannage, or the seventh if they do not have so many, and a

penny for each pig when there are fewer than seven'.²³⁵

If genuine, the charter of William, Earl of Warwick (1153-1184) to the burgesses of Swansea granted them pasture for their animals in the woods as far as they could go during the day provided that they returned to their homes by nightfall, and allowed them to keep swine in the woods, and also firewood (nemus ad ignem), and oaks for making their houses, fences and ships (quercum ad domos suas et sepes et naves suas faciendas), as well as small game, but excluding deer, wild boar and martens.²³⁶ Most of these features reappear in the detailed and liberal charter granted to the same burgesses of Swansea in 1305-6 by William de Breos. The charter shows, inter alia, the desire to utilize the woodlands to stimulate commerce by fostering the local shipbuilding industry: 'We do grant unto them [the Burgesses] reasonable Estovers in all and singular our woods above The Wood, except the wood of Predewen, to be taken in places most convenient for them (to wit, dead wood for fuel, and oak wood for building and repairing their houses within the Liberty of our Borough of Swansea, and for building and repairing their ships and boats) by the view and delivery of our Forester. So nevertheless, if having been once, twice, or thrice warned, he shall neglect or will not fulfil his office (yet so long as he may be conveniently found), then at length by reason of his default let every one take out of the same [woods] what shall seem unto him necessary for the purposes aforesaid.

And they may, likewise, have and take the rest of the woods when they will for their necessary uses in form before mentioned. But it shall not be lawful for them to sell or give anything out of the aforesaid woods to any stranger, except to guests and travellers coming to our said Borough during the time of their tarrying, yet they may be welcome to give or sell to one another. And they may make and have, if they will, out of the woods aforesaid, four great ships or fewer together and successively; but we grant to them that they may out of the said woods build as many boats as they will, able to carry twenty casks of wine or less, paying to us and our heirs for every new-built ship or boat 12d... Nor shall it be lawful for them to take anything out of the said woods but in the daytime, and that in form aforesaid.²³⁷

Supervision of felling and removal of forest products by the foresters was an important feature, and the rules concerning it were often explicit. For example, in the charter of William de Breos to the English and Welsh of Gower in 1306, wood could be taken 'under the watch of my forester (per visum forestarii nostri) if he be present, but if not, a horn should be blown three times by the one who has come to seek for whatever necessities in the said woods, and if he has no horn, he should strike a tree three times with an axe (tribus vicibus arborem cum securi percuciendo)²³⁸ and await the arrival of the forester. If the forester did not arrive within a reasonable time, the necessary wood could be taken without let or hindrance.

The development of forest industry in Wales was seriously affected by rebellions and by pestilence intermittently during the 14th century. In Glamorgan, for example, the revolt of Llewelyn Bren resulted in disruption of operations in the upland forests. The yields of the forest of Senghennydd in 1316 were reduced because operatores in puteis carbonum recesserent de foresta in guerra (workers in the charcoal pits fled the forest in the war), and in Machen Forest plures homines qui solebant exercere dictam forestam destruebantur tempore guerrae (many men who used to work the said forest were destroyed at the time of the war).²³⁹ The Black Death came into Wales in 1349 and the effects of the plague were felt well into the 1350s, viz. depopulation, tenements in decay, loss of tenants and rents. A second though milder pestilence struck Wales in 1361-2. The effects of the pestilences were greatest on the manors, which were being reduced to a stage of decadence.²⁴⁰ The practice of letting the demesne land became widespread, and profits from pannage and timber declined, but the drastic effects of the Black Death on the rural economy were overshadowed by an event even more disruptive to the economic life in Wales, viz. the Owain Glyndŵr rebellion, which started in 1400 and continued for a decade or more. The devastation caused by this war resulted in a breakdown of organization and doubtless in an extension of the area of scrub and secondary woodland on abandoned farmland. The situation in the early part of the 15th century in north-west Wales is graphically described by Sir John Wynn of Gwydyr: 'all the wholle countrey then

was but a forrest, rough and spacious as it is still, but then wast of inhabitants, and all over growen with woods, for Owen Glyndwrs warres beginninge in Anno 1400, contynewed fifteene yeares w'ch brough such a desolacion, that greene grasse grewe one the market place in llanroost [Llanrwst] called Brin y Botten'.²⁴¹

Though economic conditions improved generally in the 15th century, the Wars of the Roses caused further devastation in some places, which Wynn again described: 'Yow are to understand that in those dayes the countrey of Nanconway was not onlie woodded, but also all Car'r' [Caernarvonshire], Meriionythshire, and denbigheshire seemed to be but one forrest and wood, havinge few inhabitants'.²⁴²

3. The Monasteries

In the Medieval period, simultaneously with the establishment of hunting forests and the military clearances of native woodlands, the third great influence on the forests of Wales was the development and management of the monastic estates. Many different orders established houses in Wales during the Middle Ages, and by the start of the Tudor period there were still 47 religious houses in Wales.²⁴³ The Cistercian abbeys were the most numerous and certainly the most important with regard to the forests, and the following discussion is based mainly on these, though it should be remembered that other religious houses, even quite small ones, often cleared woods and also owned and managed woods.

The Cistercian monasteries and nunneries in Wales are listed in Table 9, with the dates of their establishment and dissolution.

Table 9. Cistercian monasteries and nunneries in Wales

<u>Monasteries</u>	<u>Established in</u>	<u>Dissolved in</u>
Basingwerk (Flint)	1131	1536
*Conway (Caernarvon)	1190	1536
Cwmhir (Radnor)	1176	1536
Cymer (Merioneth)	1199	1536
Grace Dieu (Monmouth)	1226	1536
Llantarnam (Monmouth)	1179	1536
Margam (Glamorgan)	1147	1536
Neath (Glamorgan)	1130	1539
Strata Florida (Cardigan)	1164	1539
Strata Marcella (Montgomery)	1170	1536
Tintern (Monmouth)	1131	1536
Valle Crucis (Denbigh)	1201	1536
Whitland (Carmarthen)	c. 1157	1539
<u>Nunneries</u>		
Llanllugan (Montgomery)	before 1236	1536
Llanllyr (Cardigan)	c. 1180	1536

*also known as Aberconway, Maenan or Aberllechog abbey.

Another Cistercian house, Abbey Dore (Herefordshire) 1147-1536, was close to the Welsh border and was sometimes included in the Welsh order.

The energy and knowledge which the Cistercians brought from their mother foundations in France were a potent instrument for change in land-use in Wales. The economic activity of the Cistercians in Wales has been described in detail, notably by D.H. Williams,²⁴⁴ who deals mainly with assarting, i.e. forest clearance for agriculture. Though the surviving documentary evidence of the Welsh monastic establishments is relatively scanty, it can be analysed to shed some light on the management of the forests of the monastic estates, as well as forest clearance.

Much of the land granted to the Cistercians in Wales lay originally in undeveloped wooded areas, and most of the lands of the Welsh Cistercian houses have been identified and mapped (see Fig. 6).

The lands of the Cistercians were extensive, e.g. the Abbey of Conway alone held territory totalling over 38,000 acres, in the home estate and a number of granges, nearly all of which contained substantial areas of woodlands.²⁴⁵

The original charters and grants of land to the abbeys gave the monks freedom to assart and the Cistercians became noted for their activity in forest clearance.

Nuns as well as monks participated in assarting,²⁴⁶ which was carried out vigorously, especially in the early years of the religious houses. The charters normally use the general terms silva or nemus for wood(s), without any

The result in each case was, of course, the same, viz. the permanent clearance of woodland. The commonest form of assarting was for conversion to arable land, as Giraldus Cambrensis said of the monks of Abbey Dore in the 12th century: 'they changed an oak wood into a wheat field'.²⁴⁹ This single description is typical of countless other recorded and unrecorded acts of assart, large and small, by monks throughout Wales. The second form of assarting became frequent especially towards the end of the 13th century, e.g. in 1280 the abbots of Strata Florida and Whitland were ordered to fell and bring into cultivation (assartentur) without delay the thick woods where robberies and homicides and other enormities against the king's peace had been committed,²⁵⁰ and in the same year the abbot of Basingwerk was given an extension of the time allowed for assarting the wood of Getely (Gelli, near Whitford, Flint), which had been granted to him on condition that it be rooted up and brought into cultivation within three years.²⁵¹ The land assarted by Cistercians from the woods was often protected by a ditch and a wall, hedge or fence. The actual details of the assarting procedure employed by the Cistercians are not known, but it presumably involved felling all the trees and undergrowth by axe, removal of all the useful assortments (especially timber, bark and fuelwood), burning of residual debris on the site, and eradication of roots and stumps by mattock and burning. Ploughing would then follow. Essentially, assarting was similar to slash-and-burn cultivation (cf. p.19) but was obviously more thorough, as the land cleared was intended for permanent cultivation. The place-name Cwrt Sart, a grange of Neath Abbey, gives positive evidence of monastic assarting.

Apart from assarting, the other major activity of the Cistercians that affected the woodlands on the monastic estates was livestock husbandry, especially large-scale sheep-ranching. It is difficult to get reliable statistics for sheep populations, though the evidence suggests that flocks were large on some estates, even if fluctuating sharply as a result of outbreaks of disease. The Taxatio Ecclesiastica (1291) gives the following numbers of sheep:

Margam	5285	Basingwerk	2000
Neath	4897	Strata Florida	1327
Tintern	3264	Whitland	1100

Large-scale ranching would have required or resulted in the formation of extensive open pastures. Grazing in woodland pasture would have degraded and eventually eliminated the woodland unless very carefully regulated.

Timber was felled on the estates of the monasteries for building houses and ships, and also for fuel and charcoal for iron-smelting, though of course this utilization does not necessarily imply permanent forest clearance. Indeed, selective felling of large oak for constructional timber and regular cutting of coppice for smaller material would have been the normal practice expected. For example, the monks of Grace Dieu received grants of timber from local woodlands to help in rebuilding the house after its burning in 1233, and these trees were presumably carefully selected individual oaks: 20 from the Forest of Dean (1235), 4 from Grosmont Forest (1240) and 2 from Skenfrith (1253).²⁵²

In fact, although the Cistercians were noted for their forest clearances, it could be confidently expected that the abbeys and monasteries would also be leading exponents of forest management, as they were on the continent. In Bavaria, for example, the forest ordinance of Ebersberg monastery dating from the second half of the 13th century is claimed by Mantel to be the earliest detailed forest ordinance known in Europe.²⁵³ It gives details of forest officials (magister nemoris), subordinate staff, their duties, forest products and regulations against abuses; it also indicates a sophisticated appreciation of the importance of suitable forest floor conditions for natural regeneration. Special officials such as foresters, bailiffs or woodwards were appointed to take care of the woods on monastic estates in Wales too, though their quality may have sometimes been suspect. For example, Howel Melior was said to have been inefficient in his stewardship of the Abbot of Tintern's wood at Kynemot (Monmouth) when he was bailiff there in 1340.²⁵⁴

No foresters' accounts from Welsh monasteries are known, but it is reasonable to infer a sound system of regular management and also a range of products similar to those given in the unique surviving account book of Beaulieu Abbey.²⁵⁵ This includes the Forester's Account for the forest year Michaelmas 1269 to Michaelmas 1270, and also the Tabula Forestarii, a guidebook or set of rules governing forest yield, wood measurement, and specifications and prices of forest products. This is the earliest forester's

vademecum known in Britain. The main forest products were large timber, bundles of small fuelwood, bundles of vine stakes or hedge rods, faggots, billets (coti) for charcoal-burning, charcoal, tanbark, and pannage payments. An acre (arpent) of average wood 20 years old yielded: 400 dozen bundles of small fuelwood, each bundle containing 5 pieces of round or cleft wood 3 ft. long and not thicker than a spear; 500 bundles of vine stakes or hedge rods, each bundle containing 40 stakes at least 6 ft. long; and 4000 faggots. Woods younger than the normal 20 years yielded correspondingly less, and woods difficult of access for wheeled transport were felled, cut into billets (coti) and converted into charcoal in situ. The prices of the various forest products were:

Charcoal ... 3d. per quarter (1 quarter = 8 bushels)
 Bark ... 2s. or 2s. 7d. per cartload
 Fuelwood ... 1d. per dozen bundles
 Vine stakes ... 2d. per 100 bundles
 Faggots ... 4d. per 100
 Timber ... according to size and quality, e.g. £8 per acre

The accounts show that very large quantities of forest products were harvested and sold, and substantial stocks were also kept in reserve, all this implying a carefully planned and orderly exploitation of the forest resources of the Abbey. One particularly interesting item of equipment used by the forester was the modulus, a special iron frame for preparing standard measures of timber. The modulus

was 2 ft. wide, 2 ft. long, and 6 ft. around, and was filled with wood, cleft or in the round, of the size of a man's leg and $2\frac{1}{2}$ ft. long. A measure was worth $2\frac{2}{3}$ d. in the wood, and was sold for $6\frac{2}{3}$ d. Eight of these standard measures made up a normal cart-load for two horses.

The Cistercian estates in Wales went through fluctuating periods of prosperity and decline over the centuries, being affected by wars, pestilences, and the increasing encroachment of secular authority into all their spheres of activity. In the 14th century the tendency grew to lease out lands to laymen and to live on the rents. Long before the time of the dissolution the monasteries 'were not, and had not for centuries been, the pioneers of estate management, stock-breeding, wood production, mining, and metallurgy that once they had been'.²⁵⁶ There is reason to believe that forest management would have been a relatively stable feature of the monastic economy, though the temptation for excessive felling in the period preceding the dissolution would have been strong.²⁵⁷

The actual disposal of the monastery lands, including the woods and forests and even the actual timbers of the buildings, is described in Chapter IV (p. 124). However, it is appropriate here to give details of some Cistercian monastery woods as surveyed at about the time of the dissolution (1536-9), because these forest surveys reveal age-structures that betoken careful silvicultural management for at least a century before the dissolution. The examples

indicate that the three major silvicultural systems were in existence, viz. high forest, coppice-with-standards, and simple coppice.

Gilbert's Hill, a monastic wood east of Abbey Dore, was an example of high forest; it contained '120 acres, whereof 13 acres be of 50 years growing, and the residue of an hundred years growing and above'. It was enclosed with a hedge and valued at £80 in 1535.²⁵⁸ The age structure suggests past management by clear felling or possibly shelterwood felling to produce an even-aged stand. Again, land that had belonged to the monastery of Talley (Carmarthenshire) was described in 1554 as carrying 'great oakes att a place called a quarrel, above the number of 120, being of the growth of 80 years or thereabouts, and upon the demean belonging to the late dissolved monastery, 60 oakes of the age of 50 years'.²⁵⁹

A very detailed account is available of the age-structure and valuation of a 60-acre block of coppice and coppice-with-standards on land formerly belonging to the abbey of Cwmhir (ca. 1545):

The Forest of Coyd Kyrye ap heren conteyneth 1x acres whereof ys waste xx acres, x acres of x yeres growth sett w'th shorte shrubbed oks of 1x yeres growt', reserued to one ffermo'r and three ten'ts there for theyre fyre-boote, hedgboote, and housboote, w'ch they haue byn accustomed to haue. In the same (Forest), ij acres, ijd., of one yeres growt'; ij acres, iiijd., of ij yeres growt'; ij acres, vjd., of iij yeres growt'; ij acres, viiid., of iiij yeres growt'; ij acres, xd., of v yeres growt'; ij acres, xijd., of vj yeres growt'; ij acres, xiiijd., of vij yeres growt'; ij acres, xvjd., of viii yeres growt'; ij acres, xviijd., of ix yeres growt'; ij acres, xxd., of x yeres growt'; ij acres, ijs., of xij yeres growt'; ij acres, ijs. iiijd., of xiiij yeres growt'; ij acres, ijs. viijd., of xvj yeres growt'; ij acres, iijs., of xvij yeres growt'; and ij acres, iijs. iiijd., residue of xx yeres growt'; and xx acres, vijli. xiiis. iiijd., of the same, thyn sett' w't' oke of 1x yeres growt', the wood of euery acre aforesayd valued as apperithe, w'ch is in the holle vijli. xvs. xd.²⁶⁰

This shows an almost perfect classical coppice with 15 blocks, each of 2 acres, carrying simple coppice 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18 and 20 years old; in addition there were 10 acres of coppice 10 years old with short shrubbed oak [standards] 60 years old, and a further 20 acres of coppice 20 years old with a few oak standards 60 years old. The shrubbed oak standards had probably been subjected to lopping. The whole wood was valued at £7 15s. 10d.

Shrubbing or lopping off of branches, often to a considerable height on the stem, was frequently practised, e.g. as a means of providing winter fodder for livestock. Complete pollarding of trees was also deliberately practised in some places, e.g. at Abbey Dore a lease in 1529 specified that 'the great oak, or the elm, or the poll wood' were not to be cut.²⁶¹

More examples of forest acreages, age structures and species compositions are known for the estates of many English monasteries,²⁶² and these also show the different management systems used, viz. high forest, simple coppice, and coppice-with-standards.

Accordingly, though the evidence available for forestry on the estates of the Welsh Cistercians is fragmentary, it is certain that these estates exhibited a picture of vigorous forest clearance over considerable areas in the early period, probably coupled later with relatively efficient management of selected woodlands on a sustained-yield basis.

CHAPTER IV

THE SIXTEENTH TO EIGHTEENTH CENTURIES

1. Estate-building

2. The growth of forest-based industry

- i) Charcoal
- ii) Shiptimber
- iii) Tanbark
- iv) Pitwood

1. Estate-building

It is clear from the foregoing that although the principles of forest management were known and practised in some places, especially on the monastic estates, the remaining woodlands of Wales were subject to great pressures from a growing population, expanding arable and livestock husbandry, and developing wood-based industry. Protection of woods from livestock browsing after felling was of vital importance to secure adequate regeneration, whether by seedlings or by coppice. Though awareness of the value and importance of forests had been evident at an individual or local level for centuries, the consequences of negligence, abuse, and deliberate clearance for military reasons or personal profit had reduced the woodlands to such a level by the 15th century that for the first time the conservation of the remaining forest resources became a matter of concern by central government, as evidenced by the enactment of the Statute of Enclosure in 1482.²⁶³ This was an Act for Enclosing of Woods in Forests, Chases and Purlicus*. It applied only to the royal forests, chases and purlicus, and it enabled landowners to enclose their lands against deer and cattle for seven years after each coppice felling. This purely permissive act indicates that the short periods of

*Purlicus were lands that had been afforested (in the legal sense) and subsequently disafforested.

enclosure previously employed had often been inadequate to ensure satisfactory coppice regeneration.

The decline of individual forests and of the total forest area of Wales is difficult to quantify precisely. Machen Forest, a few miles north-west of Newport (Monmouthshire) is probably fairly typical of many forests, especially in south Wales, and may serve as an example, because something of its decline can be traced from the surviving records, though these are fragmentary and the accountancy is sometimes difficult to follow.²⁶⁴ Machen Forest had been worked intensively for charcoal and other products certainly since the beginning of the 14th century (cf. p. 94) and presumably before that. The main sources of income shown in the detailed surviving account for 1447/8 were 'Wodekevyl' (wodegavell, i.e. rents paid in commutation of wood-carrying services), pannage of pigs, and 32⁴ loads of sawn boards and small boards (summagiorum asserum et parvarum tabularum); no income was obtained from swarms of forest bees that year. The summary statement of the account for 1447/8 is as follows:

MACHAN FORESTA.

Officium receptoris foreste ibidem valet hoc anno, videlicet de redditu assiso, 16s. 6d.

Item, valet de proficuis casualibus, videlicet de examinibus (nihil) apium et de asseribus et parvis (54s.) tabulis hoc anno venditis ac de pannagio (£14 17s. 4d.) ibidem hoc anno, £17 11s. 4d.

Summa valoris, £18 7s. 10d.

Deductis inde, videlicet in allocacione redditus (2s. 6d.) et reparacionibus (6s.) , 8s. 6d.

Et valet ultra, £17 19s. 4d.

A translation follows:

Machen Forest.

The office of receiver of this forest is worth this year from the fixed rent 16s. 6d.

Item, casual profits are worth £17 11s. 4d., viz. from swarms of bees (nothing) and from sawn and small boards sold this year (54s.) and from pannage this same year (£14 17s. 4d.).

Total value, £18 7s. 10d.

Deductions 8s. 6d., viz. in rent allowance (2s. 6d.) and repayments (6s.).

And finally it is worth £17 19s. 4d.

Income from pannage of pigs in Machen Forest showed considerable fluctuations, reflecting the irregularity of mast production and also the progressive deterioration of the forest during the 15th century; the following pannage incomes are cited by Pugh:

1401/2	£30 17s. 11d.
1444/5	nothing
1445/6	nothing
1446/7	nothing
1447/8	£14 17s. 4d.
1497/8	nothing
1503/4	£ 1 0s. 0d.

Pannaging herds of swine represented the progressive consumption of a capital asset, and the deterioration of the forest may also be gauged from the decline in revenue paid to the Receiver of Newport for Machen Forest over the period 1401-1522 (Table 10).

Table 10. Payments to the Receiver of Newport for
Machen Forest, 1401-1522.

Year	Payments made			Arrears owed			Total		
	£	s.	d.	£	s.	d.	£.	s.	d.
1401-2	19	11	4	8	16	10	28	8	2
1434-5	10	0	0	11	18	10	21	18	10
1446-7	2	8	8	14	0		3	2	8
1447-8	12	0	0	5	19	4	17	19	4
1451-2	nil			1	2	4	1	2	4
1456-7	nil			14	0		14	0	
1465-6	3	2	0	nil			3	2	0
1497-8	9 0			nil			9 0		
1503-4	1	4	7	nil			1	4	7
1521-2	14 0			-			14 0		

The survey of his estates ordered by the Duke of Buckingham in 1500 included the forests of Machen and Coed Meredydd. The survey clearly showed the poor condition of the woods:

'yt appereth that yn all the seid woodes ys nother underwode, nor but littell faire tymbre, but the moste substaunce therof stondeth in gret olde okes, wherof

no wodesale ys to be made, not lytell other profite therof will growe, but pannage of swyne onely, when mast falleth. Gret and yn maner extreme wast and distruccion hath be doon yn the seid woodes in yeres passed ...' In other words, the forest consisted mainly of overmature oaks, worthless as timber; few timber trees were present, no underwood, and little or no regeneration. Similar 'gret defaultes' were also found in Brecon Forest.

The example of Radnor Forest also shows how badly the forest had deteriorated. An Elizabethan Inquisition (3 Oct. 1564) described the 3000-acre forest as consisting of 2000 acres of heath and moor, 800 acres of low-grade scrub, and 200 acres of reasonable grazing land:

The said Forest of Radnor doth extend to the number of three thousand acres of all sorte and kindes of lande, or thereabout, viz. two thousand acres of wast heath and wild, foggy and marish ground; viij [hundred] acres of lowe shrubbes and bushe of smalle hazill and thornes utterly destroyed by reason the same have been hewen and cutt down by th' inhabitants dwelling there about all waies owt of season, and at the spring tyme eaten and consumed wth wild bests and goats. Two hundrethe acres thereof lieng in sondrie landes of the said forrest, is somewhat more batefull than the rest, or whereon shepe and other cattell most comenly doo pasture.²⁶⁵

Although the medieval forests were in decay throughout Wales, the administration of forest law continued to cause problems, and this resulted in 1535 in the passing of an Act for the Abuses in the

Forests of Wales (27 Henry VIII, c. 7). This act did not directly affect the forest vegetation or management in any way, but it did give relief from 'certain unreasonable Customs and Exactions', viz. (1) imposition of fines on persons passing through the forests without official tokens, i.e. passes, or without payment of an annual fee; (2) confiscation of money plus mutilation or a fine on anyone found off the highway in the forest; and (3) confiscation of stray or stolen cattle found in the forest. This Statute enacted:

that it shall be lawful from thenceforth to all and every the king's true Subjects ... freely and quietly and in Peace to pass and repass travel and go into and through the said Forests, and every of them, both on Horseback and on Foot, as well following and driving of Cattle, as with carrying of Wares; or otherwise about their lawful Business and Affairs, without any Fine Forfeiture Toll Custom Exaction or other Imposition to be taken exacted or demanded of them, by the said Foresters Rulers Walkers Farmers or their Assigns ... And further ... that if any Manner of Beast or quick Cattle ... do come into any of the said Forests by Strays, Thieftstolen or otherwise and there be marked and seized by any of the said Foresters Rulers Walkers Farmers or their Assigns ... the Owner and Owners of the same Cattle, within one Year and a Day next ensuing, chance to find the said Cattle so taken, and lawfully prove the same to be his or their own proper Cattle, that then the same Cattle to be redelivered to the Owner or Owners thereof ... 266

At this period, with much legislation important for land use in Wales, i.e. the Act for the Abuses in the Forests of Wales (1535), the Acts of Union (1536, 1542)

and the Act Establishing the Court of Augmentations (1536) for the dissolution of the monasteries, it is possible to deduce a general picture of the land-use of much of Wales, including the extent and condition of the forests, from Leland's account (1536-1539).²⁶⁷ In the coastal zone of south Wales the woods were mainly restricted to the river valleys, but the upper reaches of all the valleys were well wooded, and much of the hill-land still carried wood, e.g. the forest of Llund Coite (Llwyd Coed, near Hirwaun, Glamorgan).^{*} All the lower lands of eastern Wales, from Flint to Monmouth, were still generally well-wooded, with particular mention of 'great plenty of mervelus good woodde, and thorough reasonable wood' in the Chirk area, and the forests of Clunne (Clun), Kery (Ceri) and Kidowen (Cedewain). In north Wales there was good wood in the valleys of Caernarvonshire, Denbighshire and in parts of Merioneth. However, extensive areas in the west were largely denuded of wood, e.g. the Llŷn peninsula, Eifionydd, Anglesey, western Carmarthenshire, Pembrokeshire, Cardiganshire and much of the uplands of mid-Wales. In Anglesey peat was dug, and in the peat were found 'great roots of trees that serve men for wood'; in Llŷn the fuel was 'turffes, ferne, and gorsses'; Pembrokeshire was 'sumwhat baren of wood' except for a few parks and the forests of Narberth and Lloydarth. In the uplands of mid-Wales, on the lands of Strata Florida Abbey, Leland identified the major causes of the deforestation of Wales

^{*}For forests and woods in Glamorgan in 1587, see Appendix 3. For named forests and major woods in Wales at the end of the 16th century, see Appendix 4.

as uncontrolled felling, browse damage, and deliberate clearance, further contributory factors being large-scale livestock grazing, peat-bog formation, and felling for lead-smelting. His account, often misquoted, is here cited in extenso:

Many hilles therabout [i.e. at Strata Florida] hath bene well woddid, as evidently by old rotes apperith, but now in them is almost no woode. The causes be these; first the wood cut doun was never copisid, and this hath beene a great cause of destruction of wood thorough Wales. Secondly after cutting doun of wooddys the gottys [goats] hath so bytten the young spring [coppice regeneration] that it never grew but lyke shrubbes. Thirddely men for the nonys destroyed the great woddis that thei shuld not harborow theves ... Al the montaine ground bytwixt Alen [Elan] and Strateflure longgeth to Strateflure, and is almoste for wilde pastures and breeding grounde, in so much that everi man there about puttith on bestes as many as they wylle without payng of mony... The pastures of the montaynes of Cairdiganshire be so great that the hunderith part of hit rottith on the ground, and maketh sogges and quikke more by long continuance for lak of eting of hit ... a hille side Clothmoyne, wher hath bene great digging for leade, the melting wherof hath destroyed the wooddes that sumtime grew plentifulli therabout.²⁶⁸

In 1536 and 1542 the Acts of Union were passed, uniting Wales with England to form a single state. Thenceforth, all legislation became applicable to all of Wales as well as to England, English methods of law and administration were extended to all parts of Wales, and the English system of shires and hundreds became the basis of local government. One immediate effect was to make the new Reformation legislation applicable to Wales, thus making possible the reform of the Church in Wales and the confiscation of the properties of the Welsh monastic houses. Another important

effect was the introduction of primogeniture in place of gavelkind, the Welsh system of inheritance. The gradual effect of this was to prevent further fragmentation of holdings and create conditions more favourable for the building up of landed estates, though some large estates with important areas of woodland were already in existence, e.g. William Vaughan's estate of Corsygedol in Merioneth contained 1000 acres of wood and 1000 acres of underwood in 1525.²⁶⁹

The 47 religious houses in Wales were surveyed in 1535 and their values recorded in the Valor Ecclesiasticus. All the houses were dissolved in the period 1536-9. The leasing and sale of the monastic properties was handled by a court specially formed, viz. the Court of Augmentations, with officers including Masters of the Woods, Surveyors of the Woods and a Woodward in each county.²⁷⁰

As already indicated (pp. 105-114) the monasteries were often noted for their woods, and Leland specifically referred to several instances in Wales, viz. Grace of Dew (Grace Dieu) and Llantarnam are both described as 'standing in a wood', Whitland was 'in a vast wood', and both Llanegwhist (Valle Crucis) and Conway were described as having 'meately good woode'.²⁷¹ However, beside the woods growing on the lands of the monasteries, the actual buildings themselves contained timber of great value. These timbers were dismantled and sold, or used in the repair and maintenance of royal castles. For example, the beams

and 'sparres' from the roof of Conway Abbey were dismantled and shipped to Caernarfon for use in royal buildings such as the castle, King's Hall, and Shire Court.²⁷² This indicates the high value placed on worked timber, especially in large structural sizes, and perhaps also the increasing difficulty in finding suitable material in the remaining forests in Wales.

At first, leasing was the preferred means of obtaining income from the monastic estates. Crown leases were usually for 21 years, and woods were nearly always carefully reserved in these leases. However, increasing financial pressure soon caused the Crown to start selling its interests in the former monastic lands. Surveyors of woods were appointed in Wales, e.g. William Cowper and David Clayton (alias Cleyton or Clutton) in 1545,²⁷³ and in 1546 Geoffrey Gate was appointed surveyor general of woods in south Wales as Clayton had died and Cowper had resigned.²⁷⁴ The work was not easy, and valuations were doubtless hasty and arbitrary. In his study of the monastic economy on the eve of the dissolution, Savine admitted that he did not understand the principles of forest management employed (he evidently did not understand coppice-with-standards), but his comparison of valuations in the Valor Ecclesiasticus and other surveys such as the Suppression Surveys does justify his conclusion 'that all the calculations of income from wood in the sixteenth century were exceedingly arbitrary'.²⁷⁵

Sales of land were on such a scale that by the accession of Elizabeth I (1558) less than a quarter of the former monastic land remained in the Crown's hands.²⁷⁶

The biggest buyers of monastic land in Wales were local gentry who applied direct to the Court of Augmentations. They had to be men with ready cash, or men able to raise cash quickly. A few examples may be given of this acquisition of former monastic woodlands in Wales: in 1545 Thomas Herbert and William Breton acquired from the lands of Grace Dieu 'woods called Mylnewood (20 ac.), New Parke (10 ac.) Priors Wood (4 ac.) and Grange Than (12 ac.)' but not the two woods 'called Peresgraunge Wood and Monches Wood, 40 ac.'²⁷⁷

Also in 1545 Thomas Irelonde of Shrewsbury acquired two woods called Coyde Imynoghe (Coed y Mynach, Monk's Wood) and Coyde Varleygh More (10 ac.), formerly belonging to Conway Abbey.²⁷⁸ In 1543 Sir Rice Mansell bought for £642 9s. 8d. lands formerly part of Margam Abbey; these lands included 26 acres of woods and coppices: Cryke Woode (11 acres), Little Crykewodde (4 acres), Kelley Gredyke Coppes (3 acres), Myddecrofte Coppes (3 acres), Bollys Coppe (3 acres) and Lytle Bolys Coppe (2 acres 1 rod).²⁷⁹

In 1546 Sir Edward Carne paid £727 6s. 4d. for former monastic properties in Glamorgan, including '200 oaks being timber of 100 years growth'.²⁸⁰ Sir John Williams acquired a parcel of the possessions of the monastery of Cwmhir including the 60 acres of coppice and coppice-with-

standards already described (see p.113).²⁸¹

Men able to buy monastic land could, if they so wished and subject to the local market, make an immediate profit from the sale of woods and underwood, or could continue to manage (or mismanage) the woods they had legally acquired. With the creation and development of small and medium estates there was increasing difficulty in distinguishing between legitimate appropriation and illegal encroachment, especially on cytir (joint-land) where hereditary proprietors had a share in the pasture, wood and waste which the community controlled. The records of the Court of Augmentations give many examples of complaints over alleged spoil of woods and illegal felling and utilization of woods on former monastic lands. Table 11 shows some examples.

Table 11. Examples of offences concerning former monastic woods.

Former Abbey	Complaints involving woods	Source: Records of the Court of Augment- ations. UWP. 1954.
Basingwerk	cutting down great woods, underwoods and young springs	p. 98
Conway	felling oaks and woods, selling bark, cutting of tops of trees a little above mid height	p.124
Cymer	spoil of woods, felling and carrying away 400 oaks	p.124
Llantarnam	cutting down 20 great oaks	p.132
Margam	taking frith stakes and wood	p.110
Strata Marcella	wrongful entry and felling of woods	p.121

The practice of cropping or pollarding of oak was widespread. In north Wales three defendants were charged with

cutting down 'timber tops a little above the myddell, and so continually do they spoil that within a mile or two you shall not find one whole tree top, to the King's loss';²⁸² in 'Bennye Woode' (near Brecon) there were 120 oaks 'called cropped trees';²⁸³ in the park of Marseley (Denbighshire) there were 'stubbed and cropped trees for firewood to no. of 12240';²⁸⁴ oaks were 'topped' in the Brilley/Clyro border region of Radnorshire/Herefordshire;²⁸⁵ and in 1602 Norden surveyed the forest of Coed y Gaer, in the Lordship of Oswestry, and described it as being 'full of olde Pollarde oakes which have been shrowded out topt and dye all for the most part'.²⁸⁶

The growing concern for the wood resources of the country was expressed in the Statute of Woods or Act for the Preservation of Woods (1543), the preamble of which pointed out the great decay of timber and woods and the manifest likelihood of scarcity and lack of timber and fuelwood. The Statute of Woods was a prohibitive act applying to all woods throughout the kingdom and designed to prevent further wastage of woods. Its main provisions were:

- (i) 12 standils or storers (i.e. standards) of oak were to be left standing on every acre of coppice wood or underwood felled at 24 years old or under;
- (ii) if 12 standils or storers of oak were not present, other species (elm, ash, aspen or beech) were to be left to make up the number of 12 to the acre;
- (iii) any standils or storers of oak (or failing these the other hardwood species) left at earlier fellings were to be retained at the next felling, and kept to form timber trees;

- (iv) the standils or storers were to be kept until each of them was 10 inches square within 3 foot of the ground;
- (v) any owner not ensuring that the standils and storers were left was to be fined 3s. 4d. for each standil or storer not left.
- (vi) any owner causing the standils and storers to be felled contrary to the act was to be fined 3s. 4d. for each standil or storer so felled.
- (vii) coppices worked on a rotation of 14 years or less were to be enclosed and fenced for 4 years, with a fine of 3s. 4d. per acre per month for non-enclosure;
- (viii) coppices worked on a rotation of 14-24 years were to be enclosed and fenced for 6 years, with a fine of 3s. 4d. per acre per month for non-enclosure;
- (ix) when woods or coppices having standards over 24 years were felled or weeded (i.e. thinned), then 12 trees of oak (or failing these, of elm, ash, aspen or beech) were to be left standing for the next 20 years and the felled areas were to be enclosed and fenced for 7 years, under a penalty of 6s. 8d. per tree felled in excess of the prescribed figure and 3s. 4d. per acre per month for non-enclosure;
- (x) no coppice woods of 2 acres or larger were to be converted into pasture or arable if more than 2 furlongs from the house of the owner or tenant, under penalty of 40s. per acre.²⁸⁷

However, the Act did make provision for woodland owners to make fellings to meet any genuine domestic and agricultural requirements. It is not easy to determine how effective the Statute of Woods was in practice. In 1570 it was amended by increasing the period of enclosure by 2 years in each case, for it had been found by experience that the original periods prescribed were insufficient to provide adequate regeneration. Certainly, the Crown made efforts to ensure that the provisions of the Act were obeyed. In 1584, the farm of the 100-acre Benny Wood (Venny Wood, a few miles west of Brecon) was granted by letters patent to Richard Price to hold for 21 years.²⁸⁸ All great timber trees, all sapling oaks fit for timber, and 'sufficient les Stadells' (i.e. standards) in each acre of the premises were reserved to the Crown. Price was required to cut the said wood only twice at fit and suitable times, to enclose it with hedges and ditches, to keep it free from damage by not putting any horses or other animals into it, and to deliver up yearly 'sufficient les Staddles' in each acre of the wood.

In addition to growing concern for preservation of natural regeneration and enclosure to protect coppice regrowth, the 16th century saw the start of recorded planting of timber trees for commercial purposes in Wales, though planting for shelter and for ornament had been practised for centuries (cf. p.50). Following a survey of the Lordship of Denbigh in 1563, which revealed a shortage of timber, the tenurial structure was reformed and standard leases for 21 years were

issued. These leases obliged the tenant to plant specified numbers of timber trees in an attempt to remedy this timber shortage. For example, a lease of 1564 required the tenant to plant 180 trees, either oak, ash, elm, poplar or walnut.²⁸⁹ The leases issued by the Crown later in the century also included the obligation to plant timber trees, e.g. in 1592/3 a tenant was to plant 400 trees of oak, elm, beech^{*} or poplar within 3 years.²⁹⁰ Seven other similar leases issued in the Lordship in 1593 required the tenants to plant a total of 4180 trees within periods of 3 or 7 years.²⁹¹ Planting for river-bank protection was also practised, for in 1561 a jury empanelled in the Lordship of Glasbury (Radnorshire) recommended the planting of three rows of osiers on the bank of the Wye, the osiers to be 3 inches compass (i.e. circumference), $1\frac{1}{2}$ yards long and $\frac{3}{4}$ yard apart.²⁹²

With the growth of private estates in Wales, planting to embellish the country houses had already been in vogue for some time. Owen's description of Pembrokeshire^{**} refers to 'prettie groves of woodde, as oake, ashe, mapple, Elme, and such like, and diuerse rare tymber, as the pyne aple tree [presumably Scots pine], the spruse, and fyrre trees, the Mulbery tree & others' planted around 'houses of accompte'.²⁹³ Towards the end of the 16th century at Haroldston (Pembrokeshire) Sir Thomas Perrot established pheasants 'in a pleasante grove of his owne plantinge'.²⁹⁴ The voyages of discovery resulted in new trees being introduced to Wales from North

* Beech is here well outside its accepted natural range in Wales.

** For named forests and woods, see Appendix 5.

America, including the 'Firre tree':

"Master Thomas Bowen of Trefloine in the County of Pembroke ... had about fifteene or sixteene yeares past [i.e. ca. 1596] manie young and small plants of this kind brought him home by saylers from the Newfound land, with some of the earth wherein they did formerly grow, and planted them together with the said earth in convenient places about his house, where they have since so well prospered that many of them at this present [i.e. 1612] are about foure foot in circuit, and also very high and tapering. And they will grow upon mountaines, gravellie soyles, or in good earth, either by planting the young tree, or sowing of the seed ²⁹⁵

This is the first recorded introduction of exotics to Wales from North America, and also the first record of planting and direct sowing of conifers in Wales. Moreover, stress is placed on the fact that the trees were planted in soil brought from North America, and mycorrhizae would have been unwittingly introduced as well. It is not certain whether one or more species of conifer was involved in this introduction, and the precise identity of the 'firre' is also uncertain, but in view of the place of origin and the reported rapid growth rate, Pinus strobus appears to be the probable species. ²⁹⁶

In the 16th and 17th centuries it becomes possible for the first time to estimate with some degree of reliability the percent forest cover in Wales from recorded 'statistics', i.e. acreage figures given in various surveys, fines, inquisitions and recoveries (cf. Table 12). It must, however, be remembered that accurate surveys were not possible at that period, and the acreages given are only approximate indications of the

Table 12. Area and % woodland in randomly selected estates from various parts of Wales in the 15th to 17th centuries.

Place, county	Date	Total area (acres)	Woodland area (acres)	Woodland (%)	Source
Abercynrik, Brecon	1673	1900	100	5.2	Hist. Mem. Brec. I 56
Tre Jewarth etc., Anglesey	1633	107	2	1.8	Bangor MS. 17589
Brinford etc., Flint	1588	76	4	5.2	Bangor MS. 17082
Llanvaghan, Caerns.	c.1550	1000	<100	<10	Rec. Augmentations 58
Clenennau, Caerns.	1683	1640	300	18.2	NLWJ 13 p. 280
Clyro, Radnor	1555-6	106	6	5.6	Rad. Soc. Tr. 1975 53
Corsygedol, Merioneth	1525	6000	1000	16.6	Mostyn MS. 379
Cwmgoror etc., Mont.	1597-8	74	4	5.4	Mont. Rec. 457
Llanrhaeadr-yng-Nghinm., Denbigh	1564-5	1548	8	0.5	Denb. Hist. Soc. Tr. 1973 51
Istulas, Denbigh	1592-3	864	3	0.3	Rec. Augmentations 372
Dolwar etc., Mont.	1591-2	640	40	6.2	Mont. Rec. 425
Flint, Boles, etc., Flint	1609	340	20	5.8	Bangor MS. 17087
Glasbury, Radnor	1563-4	43	2	4.6	Rad. Soc. Tr. 1975 53
Gledey, Radnor	1550	63	3	4.7	Rec. Augmentations 513
Hope, Mont.	1608-9	132	2	1.5	Mont. Rec. 521
Kerry, Mont.	1605-6	62	12	19.3	Mont. Rec. 504
Llanddeusant, Carms.	-	240	60	25	Inq. PM Eliz. 196/12
Llanfynydd, Carms.	-	32	2	6.2	Inq. PM Phil. & Mary 107/7 & 8
Llanishen, Glam.	1400	180	20	11.1	Cal. Inq. Misc. 272
Llansadwrn etc., Carms.	-	7140	150	2.1	Inq. PM Eliz. 196/12
Llanvedw, Glam.	1400	36	6	16.6	Cal. Inq. Misc. 272
Llawnithion, Mont.	1618-9	86	8	9.3	Mont. Rec. 593
Penporchell etc., Denb.	1575	106	4	3.7	Bangor MS. 17045
Rhiwhirarth, Mont.	1595-6	180	20	11.1	Mont. Rec. 441
Slebech etc., Pems.	1613	1812	367	20.2	Inq. PM Oct. 1613
Slwch etc., Brecon	1551	306	14	4.5	Hist. Mem. Brec. 42-3
Talachddu, Brecon	1551	760	100	13.1	Hist. Mem. Brec. 42-3
Tredegar etc., Monm.	1582	10,560	500	4.7	Star Chamber Proc. 78
Trewylan, Mont.	1608-9	460	20	4.3	Mont. Rec. 520
Vaynor Ucha etc., Mont.	1587-8	680	40	5.8	Mont. Rec. 417
Average % woodland				8.2	

relative proportions of the major land-use categories in the territories surveyed, e.g. lordships, manors, commotes, estates and smaller holdings. The major land-use categories distinguished were generally arable land, pasture, meadow, moor, wood and underwood, marsh, furze/heath, mountain land, and turbary. Analysis of a randomly selected number of such 'statistics' for large and small areas in various parts of Wales between the 15th and 17th centuries in fact reveals a surprisingly consistent picture with woodland generally forming under 10% of the land area and only exceptionally values over 15% (Table 12).

The most accessible published data are those for Montgomeryshire, generally recognized in later centuries as the best wooded county in Wales (apart from Monmouthshire). In fact, the data for the Barony and Lordship of Powys (Table 13) show surprisingly low percentages of woodland.

Table 13. Land-use acreages and % woodland in the Barony and Lordship of Powys, 1582 and 1622-3.

Land-use categories	Acreages in	
	1582	1622-3
Arable land	20 000	40 000
Meadow	6 000	12 000
Pasture	10 000	40 000
Wood	3 000	6 000
Mountain land	10 000	-
Heath & gorse	6 000	40 000
Moor	3 000	10 000
Total area	58 000 acres	148 000 acres
Woodland as % of total area	5.2	4

Source: Montgomeryshire Records (suppl. to Mont. Coll.) pp. 412, 616.

When data for individual manors and large estates in Montgomeryshire are analysed, a somewhat different picture emerges (Table 14), with a general average woodland percent of ca. 10%.

Table 14. Areas and % woodland in individual manors and large estates in Montgomeryshire in the late 16th and early 17th century

Manor & Date	Total area (acres)	Woodland area (acres)	Woodland %	Source: <u>Mont. Records</u> (suppl. to <u>Mont. Coll.</u>)
Carno, 1571	1780	340	19.1	p. 328-9
Carno, 1599-1600	3380	340	10.0	p. 478
Carno, 1612-3	4300	500	11.6	p. 549
Deuder, 1601-2	9100	500	5.4	p. 490
Llanbrynmair etc., 1613-4	11700	500	4.2	p. 564
Llanidloes etc., 1613-4	10000	1000	10.0	p. 551
Llanwythelan etc., 1612-3	6300	1000	15.8	p. 546
Llanllygan, 1595-6	2840	100	3.5	p. 442
Mivod etc., 1603-4	3700	300	8.1	p. 499
Montgomery etc., 1606-7	5500	100	1.8	p. 513
Montgomery etc. 1613-4	13392	1500	11.2	p. 561
Nethergorther, 1612-3	6300	500	7.9	p. 549
Strata Marcella, 1617-8	3050	200	6.5	p. 592
Teirtreff, 1621-2	790	100	12.6	p. 611
Uchcoied etc., 1608-9	4600	1000	21.7	p. 524
Average % of woodland			9.9%	

These tabular analyses, with all their unavoidable statistical imperfections, therefore show that the woodland area over much of Wales by the 16th and 17th centuries had generally reached levels of the order of 10% or less, and only in certain areas, e.g. remote valleys, was the percentage forest cover substantially higher. For example, the 1590 survey of the commote of Cyfeiliog (Powys) showed that the Dyfi valley was one of the best wooded areas in Wales, with woodland forming 21.2% of the total area of 19,490 acres.²⁹⁷

The tempo of forest destruction in Wales is partly reflected in the times of final disappearance of native species of woodland fauna, viz.

brown bear	long before the Norman Conquest
wolf, wild boar	probably in the 16th century
red deer	end of 18th century
roe deer	much earlier than the red deer ²⁹⁸

The overall reduction in woodland area in the 16th and 17th centuries appears to have been due mainly to continued widespread assarting of remaining woodlands (cf. pp. 107-8) and many hundred of cases illustrating this are documented.²⁹⁹ In this period there are repeated references to the fact that corn is now growing where good timber once stood, e.g. in the Forest of Cilgerran (in N. Pembrokeshire).³⁰⁰

Many place-names in Wales provide evidence of assarting, i.e. the process of land-clearance with the aid of fire.³⁰¹

There is the direct evidence of names such as Cwrt Sart (Neath, Glamorgan), and the indirect evidence of names containing the element poeth, plu. poethion (=hot), which is usually taken to imply 'burnt' or 'cleared by fire'. Thus Coed-poeth would denote 'wood cleared by fire', e.g. at Mitchel Troy (Monmouthshire), Mochdre (Montgomeryshire) and Bersham (Denbighshire); similarly, Pentre-poeth would denote 'village on a site cleared by fire', e.g. at Swansea (Glamorgan), Llandyfaelog (Caernarvonshire) and Radyr (Glamorgan). Numerous examples of names incorporating poeth(ion) can be cited, e.g.

Acre-boeth	(= acre ...)
Allt-boeth	(= wooded slope ...)
Bryniau poethion	(= hills ...)
Caeau poethion	(= fields ...)
Coed-poeth	(= wood ...)
Derwen-boeth	(= oak ...)
Pentre-poeth	(= village ...)
Plas-poeth	(= mansion ...)
Tai poethion	(= houses ...)
Tyddyn poeth	(= cottage ...)
Ynys boeth	(= island/lowland ...)

The clearance of forest and the growing shortage especially of the better grades of oak timber is described in general terms for England and Wales by Holinshed in 1586,³⁰² and specifically for Wales by the poet Thomas Churchyard (1520-1604), who gave an account of the Welsh border counties from Monmouthshire to Flintshire in verse in 1587:

'They have begun, of late to lime their land,
 And plowes the ground, where sturdie okes did stand
 ...
 They teare up trees, and takes the rootes away' ³⁰³

Land-grabbing was practised on a large scale by the gentry and by industrial entrepreneurs, but countless small encroachments by 'little men' probably had a greater effect overall in reducing the woodland area. Encroached land was enclosed by ditches, hedges and walls, and this frequently gave rise to bloody intervention by commoners who saw their ancient rights being usurped. Numerous cases of encroachment in west Wales in Elizabethan times, especially in the royal forests, are instanced by Owen,³⁰⁴ but here it will suffice to give brief details of just one example from each of the Welsh counties to illustrate the type and scope of offences:

Anglesey: felling 100 great willow trees to the loss of the Crown.³⁰⁵

Brecon: carrying away of 40 acres of woods.³⁰⁶

Caernarvon: destroying timber and woods on a waste called Gwerne Veignagh.³⁰⁷

Cardigan: spoil of hedges and trees.³⁰⁸

Carmarthen: enclosing parcels of crown lands, viz. woodlands called Coed Yssa, and felling 200 oaks.³⁰⁹

Denbigh: spoil and waste of great timber trees, and young saplings and oaks and fair ashes.³¹⁰

Flint: felling and taking away of timber, and enclosing farms out of Ewlowe Wood.³¹¹

- Glamorgan: felling and carrying away trees to make weirs in the river Rhymney.³¹²
- Merioneth: cutting and carrying away Crown timber (10,000 oaks, the waste being valued at £1500) at Llanfachreth, alleged to be within the Forest of Snowdon.³¹³
- Monmouth: wrongful entry into waste; cutting, spoiling, carrying away and selling of timber; refusal to allow servants of the crown to cut timber.³¹⁴
- Montgomery: cutting down and carrying away trees, under-wood, hazel, birch, oak, and oak saplings.³¹⁵
- Pembroke: felling of 1400 oak trees, value £700, in the Forest of Narberth and 600 oak trees, value £200, in Caniston Wood (complaint lodged by John Taverner, Surveyor of Crown woods south of the Trent).³¹⁶
- Radnor: forceful entry into a wood and woodground called Radnor Wood with divers coppices ... armed with long bills, picks, staves, swords, daggers, long pickforks, axes, hatchets, and bills; overthrowing hedges and felling trees; threat to burn down the remaining trees.³¹⁷

In 1601 an Act to Avoid and Prevent Divers Misdemeanours was passed; it provided inter alia for punishment for illicit cutting and mischievous spoiling of woods, trees, or poles.³¹⁸ Thereafter, throughout the 17th century, concern over timber supplies in general and naval oak in particular manifested itself in three main ways: (1) repeated surveys of timber resources; (2) further legislation aimed at preserving existing forests and promoting the establishment of plantations; and (3) publication of pamphlets and books devoted to timber growing.

James I took a keen interest in timber growing, and supported the publication of a pamphlet by Arthur Standish containing instructions 'for the increasing of timber and firewood' in 1615.³¹⁹ This was one of the first of many practical

treatises on forestry published in England during the 17th century. They can be classified into two main groups: firstly, manuals of husbandry, concentrating on detailed techniques of silviculture and arboriculture; and secondly, political polemical tracts arguing the need for stringent government action.³²⁰ The general effect of these publications in Wales appears to have been slight.

During the reign of James I, a breviat or survey was made of the woods in the royal forests, parks and chases in 1608. The terms of the survey were as follows:

to cause the sound trees being tymber, and other great trees which are not tymber, and dead and decaied trees, And also the said coppices ... to be thoroughly viewed surveyed and valued by skilfull and expert persons ... you shall cause the same trees, being tymber, severally and by themselves to be numbered, valued, appraised and marked with theis l'res J and R. And the said great trees, not being tymber, and the dead and decaied trees you shall likewise cause to be numbered and valued severally and by themselves. And all and singular our coppices to be estimated and valued att the yearly value of the same [being such as] may be felled and cutt downe [at their] reasonable growth and according to a reasonable rate and porcon.³²¹

The results of the survey for the royal woods in Wales are shown in Table 15. Data for only four counties were compiled and published, and it is probable that the full survey was not completed.

Table 15. Survey of Royal Forests and Parks in Wales, 1608³²²

County	No. of timber trees	No. of decaying trees	No. of saplings	Coppices out of lease (acres)
<u>Carmarthen</u>				
Forests (Penrin, Pennyhearth & Cardiffe)	6542	17,296	-	-
Riffigg Park	727	3054	-	197
<u>Denbigh</u>				
Parks	50	1595	9500	-
<u>Montgomery</u>				
Parks	640	3290	-	-
<u>Pembroke</u>				
Forests	2666	22,884	21,032	786

The coppices were valued in total at £86 per annum, the timber trees at £1352 10s., and the decaying trees at £3127 7s. 4d.; the saplings were not valued. The ratio of decaying trees to timber trees indicates that the condition of the woods was highly unsatisfactory. Marking the timber trees with the king's initials (JR) did not make them safe from depredations however, for in the Forest of Cilgerran (Pembrokeshire) even selected trees 'marked with the prince's name as special timber' were alleged to be illegally felled.³²³

Another survey in the Forest of Narberth (Pembrokeshire) in 1609 shows how sapling oaks were valued, and also how the land value was regarded.³²⁴ One parcel called Castle Lake Wood contained 60 acres 'well set with saplinge oakes ... amongst which ... are some dotard oakes of bigger proportion servinge to noe other use but fireinge'. The total number of trees

was about 21,000, and they were valued at 2d. each 'the greater with the lesse', giving a sum of £173 12s. Because the local inhabitants claimed common of estovers, the surveyor (Gilbert Thacker) reported 'I can value the soyle at no higher rate, more than the value of the wood that groweth thereon'. The surveys of the Duchy of Lancaster lordships in Wales (Monmouth, Gresmont, Skenfrith, White Castle, Caldicot and Kidwelly) have been published in ³²⁵ extenso. They show the names and areas of woods, rents and services, the traditional customs and rights of common, and also numerous cases of encroachment and spoil of woods. In general, all great trees were reserved to the king; the lessees had underwoods, dead trees, lop and top of oaks (toppis et loppis quercorum) and honey and wax; the tenants had the herbage and pannage of the wood, wind-fallen wood and customarily one oak at a time for repairing, re-building or new building on their tenements, on notice to the woodward or keeper of the wood.

In 1640 an Act of Limitation of Forests finally defined the true boundaries of the royal forests, and led to the virtual abolition of the forest courts.³²⁶ The Civil War (1640-50) and its aftermath resulted in a certain amount of destruction of woods in Wales. Landowners who had supported the king had their lands confiscated or were heavily fined, and large-scale felling took place to defray the costs of land purchase or to pay fines. Detailed Parliamentary Surveys were made of crown lands following

the Act for the Sale of Crown Lands (16 July 1649). These Surveys covered 26 items in six main sections, viz.: The Nature and Extent of the Forests; The Parks, Officers, and Profits; The Divisions; The Woods and Timber; Commoners and Encroachment; and Waste and Spoil of Woods. Timber fit for the use of the navy and standing within 15 miles of a navigable river was not to be sold. However, Madge's analysis of the Parliamentary Surveys indicates that only one Crown woodland property was surveyed for sale in Wales (out of a total of 168 woodlands so surveyed in England and Wales).³²⁷

The military owners certainly felled much timber on estates during their period of ownership under the Commonwealth. Cromwell's expansionist foreign policy meant that the 1650s were a good period for selling timber and for conversion to arable or pasture; 207 new vessels were added to the navy in 11 years, and agricultural prices were higher than they had ever been.³²⁸ On the Restoration of the monarchy, the estates of the Parliamentary purchasers, including the woodlands, underwent further disruption and damage.

In 1663, soon after the Restoration, an Act for the Punishment of Unlawful Cutting or Stealing, or Spoiling of Wood and Underwood, and Destroyers of Young Timber Trees was passed.³²⁹ It applied to woodland generally, and amplified and extended Elizabeth's Act of 1601. The following year (1664), John Evelyn published his 'Sylva,

or a Discourse of Forest Trees and the Propagation of Timber in His Majestie's Dominions'. Evelyn's work went through several editions before the end of the 17th century and had considerable influence on arboriculture and the development of commercial plantation forestry in England, but its effect in Wales was slower and less obvious. In Wales, the terms of leases had often specified small-scale planting of timber trees on farms, e.g. in Denbighshire (cf. p.131) and in Caernarvonshire, where a lease of 1624 required the tenant to plant 4 trees of oak, elm or ash each year.³³⁰ Under the influence of Evelyn, a few land-owners in Wales began to experiment with exotics for ornament and to undertake new plantations by planting and by direct sowing of oak.

Exotic conifers, though not entirely unknown in Wales (cf. p.132) were extremely rare in the early 17th century, but a manuscript by Sir Thomas Hanmer, a close friend of Evelyn, shows that by about the middle of the century Scots pine, spruce fir (i.e. Norway spruce), European larch and also cypress and cedar were being grown, though only for ornamental planting in avenues, walks and groves.³³¹ Besides Sir Thomas Hanmer's estate at Bettisfield (Flintshire), planting was also carried out in the mid 17th century on large estates such as Chirk, Gwydyr and Margam, and also on smaller estates. For example, at Tre Wydryn (Anglesey), Justice Prydderch planted beech, pine, chestnut, ash and sycamore in rows

for use and ornament (seriatim ... ad usum ornatumque),³³²
 and avenues of Scots pine and sweet chestnut at Llanvihangel
 Crucorney (Monmouthshire) were believed to have been
 planted ca. 1670.³³³ More exotics were also introduced from
 North America, e.g. Edward Lhuyd sent plants to a friend
 in Merioneth ca. 1685 and said 'The Virginia Cedar is a
 plant lately come from yt Country & I am confident was
 never in Wales before'.³³⁴ The accounts of Chirk Castle
 reveal both ornamental and commercial planting: fir (i.e.
 Scots pine) plants were acquired in the early 1660's, and
 several lots of Scots pine seed and plants were acquired
 subsequently; quite large amounts of acorns were gathered
 for direct sowing, e.g. in 1708 and 1718, and oak, walnut
 and elm were planted in the early years of the 18th century.³³⁵

At the very end of the 17th century, Edward Lhuyd
 attempted to produce a 'geographical dictionary and natural
 history' of Wales by means of questionnaire surveys of
 parishes.³³⁶ The replies to these Parochial Queries can be
 analysed to give some general idea of the condition of Welsh
 woods in about 1700, because they included information on
 'the names of the most remarkable ... woods', general land-use,
 and the main fuels. There are, however, serious limitations
 to the Parochial Queries. The response to the questionnaire
 was very patchy, and the 143 parishes described for Lhuyd
 cover only just over 15% of the total number of civil parishes
 in Wales,³³⁷ though further replies still occasionally come to
 light;³³⁸ moreover, the quality and detail of the replies varied
 considerably.

Geographical coverage of the replies to the Parochial Queries was best for the counties of Merioneth, Denbigh and Flint. An analysis of fuel usage in north-east Wales based on these replies shows a very mixed picture, with coal being recorded most frequently as the major fuel, followed by peat and then by wood.³³⁹ Wood was usually mentioned as a secondary fuel in north-east Wales, but in some places in south Wales, e.g. at Llyswen (Breconshire), wood was the sole or the main fuel.

Over 80 individual woods are named in the replies to the Parochial Queries, but rarely with any detail as to area, condition, species or management. Most replies, when they mentioned woodland resources at all, referred to it in the most general terms, e.g. 'but little wood' (Baglan, Glamorgan) or 'nid oes agos i dhim koed' (virtually no wood; Tir Ifan, Denbigh). A few individual woods are described as small, as insignificant brushwood, as containing little or no wood, or as recently felled. Wood was abundant in a few places, e.g. at Llanwynno (Glamorgan) and Trelech (Monmouth). The only species mentioned are oak (at Llanwynno/Llantrisant, Glamorgan), oak and ash (Llantilio Pertholey, Monmouth) and birch (Llangollen, Denbigh). The only indication of management is at Tir y Prenniae (Bangor, Flint), described as a small coppice. The named woods, excluding parks and commons, are listed in Appendix 6.

2. Growth of Forest-Based Industry

Over much of Wales the remaining woods and forests had for centuries been worked at a low level of subsistence utilization, to satisfy the needs of a rural peasant economy for fuel, agricultural implements and vehicles, domestic utensils, tanstuffs, furniture, and constructional timber for dwellings and larger buildings such as castles and mills (cf. p.87). The woodlands were also important for grazing and pannage. In general this widespread dependence on the native woodlands persisted until the Industrial Revolution.

In addition to this general subsistence utilization, which applied throughout Wales, forest-based industries developed which may conveniently be considered under the four main forest products: (i) Charcoal; (ii) Shiptimber; (iii) Tanbark; and (iv) Pitwood.

(i) Charcoal

Wood and charcoal had been used locally and sporadically for smelting of metal ores since Pre-Roman times. After the Norman conquest of Wales, there was increasing development of mining and smelting, especially of iron and lead, and the need for regular and often large supplies of charcoal for these medieval operations has been described (cf. pp.934). Indeed, shortages of charcoal were often the limiting factor in smelting and refining operations. The development of charcoal-based metallurgical industry in Wales before the Industrial Revolution has been described, e.g. by Lewis³⁴⁰ and Rees.³⁴¹ Charcoal-burning was associated with smelting operations from the 13th to the 15th century in eastern Monmouthshire (iron), around the rim of the South Wales coalfield (iron, lead), at Neath (copper), in a few places in north Carmarthenshire and western Breconshire (iron, lead), in Cardiganshire (lead), Caernarvonshire (iron), and in north-east Wales from the coast to Minera and Bersham (iron, lead). These same areas, and others in Merioneth, Montgomery and Pembroke, continued to form the main locations of the lead and iron industry in later centuries, and in fact charcoal continued to be used in the iron industry in some places until well into the 19th century. The demand for charcoal for the metallurgical industries at one period or another affected the woods over practically the whole of Wales (see Fig. 7).

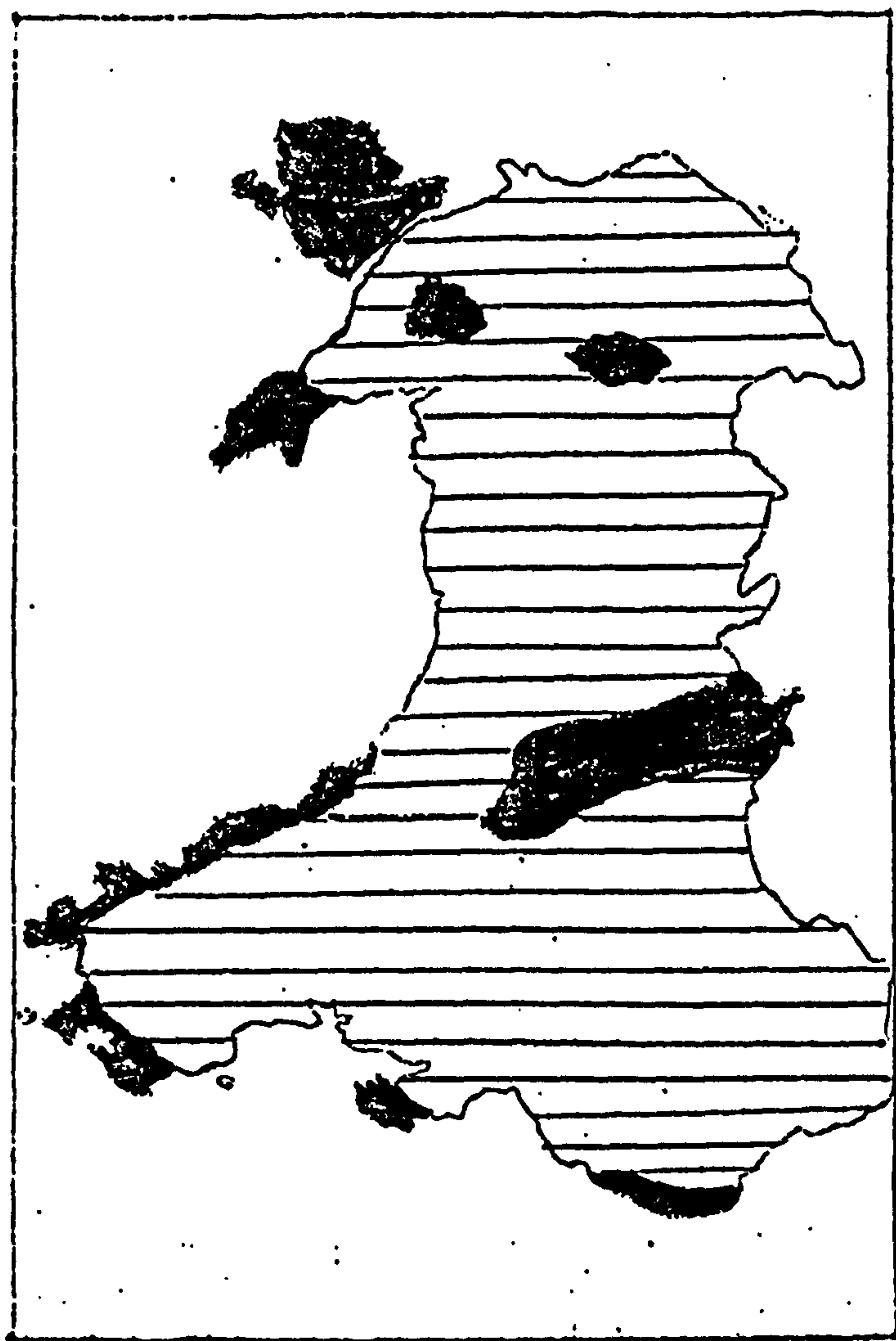


Fig. 7. Map showing the area (hatched) affected by charcoal-burning for smelting on an industrial scale at one period or another between medieval times and the 18th century (based on known locations of iron, lead and copper smelting operations, and an assumed catchment radius for charcoal of 10 to 15 miles). Shading denotes the areas presumably unaffected by charcoal-burning.

The metallurgical industry depended on wood for charcoal. Medieval miners were given privileged positions in obtaining wood, and later too the industry was given wide powers to acquire raw materials. For example, in 1486 the king's commissioners of mines were allowed to take any wood, brushwood and charcoal needed for separation, proving and purifying of the metals, and land and water carriage of the materials at reasonable price to be agreed upon with the owners, and could also arrest the necessary labourers for the mines and put them to work at reasonable wages.³⁴²

However, it was also important to safeguard sufficient large timber of structural sizes, especially for shipbuilding. The conflict of interests between these two major users of timber persisted for some centuries and the legislation enacted in the 16th century reflected this, viz. statutes for the preservation of woods, preventing the burning of timber for iron, and also licences permitting limited felling for charcoal burning. In 1558, the first year of Elizabeth's reign, was passed An Act that Timber shall not be felled to make Coals for Burning of Iron.³⁴³ This act applied to any timber tree of oak, beech or ash, 1 foot wide at the stub and growing within 14 miles of the sea or of any river navigable from the sea (specifying several rivers by name, including the Severn, Wye and Dee).

Strictly applied, this would have afforded considerable protection to the remaining forests of much of Wales. Local

exceptions were however made to this rule, and the tree species protected were altered according to local conditions. For example, on 16 July 1568 a licence for life was granted to Henry Sydney (President of the Council of the Principality and Marches of Wales) and certain others, to convert to fuel for the making of iron any trees of aspen, hazel, hawthorn, blackthorn, willow, sallow, beech, birch or any other kind of wood except oak, elm and ash, within 14 miles of the sea or of the river Severn in the County of Glamorgan only.³⁴⁴

At the king's lead and iron mines at Llantrisant (Glamorgan) the accounts for 1531 show that charcoal-burners outnumbered the actual miners.³⁴⁵ Initially the smelting operations were small and relatively mobile, with simple hearths. Accordingly there was little incentive to manage woodlands for sustained production as it was easy to move on. However, as the industrial enterprises grew larger and more static, it became more important to ensure sustained supplies of charcoal from a reasonable catchment area, the radius of which was governed by horse or mule transport. Steps were taken to secure long-term agreements. For example, in 1589 a 14-year agreement was made for the sale of wood on the manor of Coyty Anglia (Glamorgan) for making charcoal for the iron-works; the wood was to be supplied at a rate of up to 3000 cords/year at 14d. per cord.³⁴⁶ Leland's testimony shows that early in the 16th century the lead mines in Cwm Ystwyth (Cardiganshire) had largely denuded

the valley of wood (cf. p.123), andⁱⁿ 1613 the tenements of 'Compenlladan' and 'Tythin llwyn y Coydno' were acquired for their wood so that the mine-owners 'would be secure from the more uncivilized sort of inhabitants'.³⁴⁷

The iron-masters obviously had a vital interest in maintaining their charcoal supplies and therefore heedless destruction of the raw material resources is unlikely to have taken place. However, complaints against the iron-workers in their effect on the environment were doubtless sometimes justified. Three poems of the 16th century all lament the felling of local woods to make charcoal for ironworks, viz. Coed Marchan (in Denbighshire) and Coed Glyn Cynon and Coed Mwstwr (both in Glamorgan).³⁴⁸ The three poems accurately list the numerous traditional forest products and services lost to the local communities as a result of the felling and charcoal-burning operations: timber for bridges, houses and churches; firewood and twigs for fuel; game in the form of red deer, roe deer, squirrel and badger; shelter for wild birds; lovers' trysting places; hazel nuts; acorns for pannage of pigs; browse for goats; and clean spring water. The complaints were certainly exacerbated by the fact that these Welsh forests were being acquired and felled by outsiders, i.e. iron-masters from England.

A large-scale clear-felling and coaling (charcoal-burning) operation would have appeared a desecration for a while, but it was in everyone's interest to secure regeneration,

especially by coppice, and the silvicultural knowledge and legislation were available to achieve this. If large-scale felling of valuable timber and wholesale permanent deforestation did take place as a result of smelting operations, it would have been attributable more to negligence and lack of supervision than to a deliberate policy. Yarranton³⁴⁹ made this clear when he stated in 1677 that iron-works 'are so far from the destroying of Woods and Timber, that they are the occasion of the increase thereof'. His arguments were that without the charcoal demand the woods would have been cleared for agriculture, and that owners would never sell valuable timber for charcoal because it could command higher prices for other purposes.

A large charcoal-burning industry developed in many areas of Wales (cf. Fig. 7), based on the iron and lead smelting operations, and involving selection and purchase negotiations, the actual felling, cording and coaling operations, and then the bagging and transport of the charcoal to the works. Oak and beech formed the best charcoal, but any and every broadleaved species was used in the charcoal-burning operations. For example, in 1568 a licence in Glamorgan allowed the use of aspen, beech, birch, blackthorn, hawthorn, hazel, sallow, willow or any other species except timber trees of oak, elm and ash.³⁵⁰ The prime hardwood species (oak, elm and ash) were certainly used in many charcoal-burning operations. For example, charcoal analysis at Coed Ithel furnace, a 17th-century blast furnace at Llandogo (Monmouthshire) shows

that alder, ash, beech, birch, crabapple, elm, oak, and willow/poplar (and unidentified material) were used, oak and willow/poplar forming the main constituents.³⁵¹

The organization of the early woods operations in Wales can be inferred from surviving iron-works accounts and by analogy with the more detailed accounts of the Sussex iron-works before the Sussex iron-masters transferred their operations to south Wales. Employment in woodcutting and charcoal-burning fluctuated seasonally. The felling and cording work was concentrated in the winter and especially in early spring. Little felling was done in the summer, when the woodcutters were probably engaged in harvest work on the farms. In general, the bulk of the work was done by men regularly employed through most of the winter, working one piece of woodland until its supplies were used up. More men were engaged in woodcutting than in the actual charcoal-burning.

Wood was felled, cross-cut and corded close to stump. In general, the wood was cross-cut into one of two standard billet lengths, i.e. 'long' (4 ft. or 4 ft. 4 in. or 4 ft. 6 in.) or 'short' (2 ft. or 2 ft. 2 in.), but sometimes cordwood was cut into an intermediate length of 3 ft., as at Cefnmabli (Glamorgan) in 1658.³⁵² Cord size varied in south Wales, both between regions and in time, and the following cord sizes have been recorded (Table 16).

Table 16. Cord sizes in use in South Wales for mixed hardwoods for charcoal burning.

Name of cord	Cord dimensions						
	Length	Width	Height	Stacked	Approximate		
	ft.ins	ft.ins	ft.ins	vol. cu.ft.	solid vol. cu.ft.		
Statute cord	8 -	4 -	4 -	128		75	
Short cord	9 -	2 2	4 6	88		51	
Long cord	9 -	4 4	4 6	175		102	
New Weir cord	8 4	2 2	4 4	78		45	
Cefnmabli	9 -	4 -	4 6	162		94	
"	9 -	3 -	4 6	121		70	
"	9 -	2 -	4 6	81		47	
Welsh standard	9 -	4 6	4 6	182		106	
Long cord	18 -	2 2	4 6	175		102	
Monmouth	16 8	2 2	2 2	78		45	

In the 18th and 19th centuries, wood for charcoal was often sold by the ton instead of by the cord.

The amounts of wood and of charcoal needed to produce a ton of iron decreased during the 16th and 17th centuries, as technical efficiency in smelting improved. Accounts and estimates in Glamorgan in the 1560s indicate that a load of charcoal represented 4 or $4\frac{1}{2}$ cords of wood, and 5 loads of charcoal were needed to make 1 ton of iron; accordingly, 20-22 cords of wood were required to make one ton of clean iron. The wood was valued at 2d. per cord, and the cutting at 4d. per cord; coaling was put at 2s. per load; a load of charcoal was valued at 6s. 7d. In 1567-8, the annual cut for one furnace apparently amounted to 9611 cords.³⁵³ In Monmouthshire in the late 17th century, four 'short' cords, equivalent to 12 loads of charcoal, were required for the production of 1 ton of pig iron; the costs were 14s. for

4 short cords, 6s. for cutting, 1s. for cording, and 5s. for coaling, which, with carriage, came to ca. 8s. 6d. per cord.³⁵⁴ On the Cefnmabli estate in east Glamorgan, which supplied wood for charcoal for Machen forge, standard cords of 9 x 4 x 4½ ft were sold at 6s. per cord in 1658, or equivalent numbers of cords 9 x 3 x 4½ ft. or 9 x 2 x 4½ ft;³⁵⁵ later on, at Cefnmabli an agreement of 1687 specified the felling season (from 1st September to 31st March) and completion of all operations and clearance of the site by Bartholomytide (24th August), i.e. before the start of the next felling season. Prices per long cord (18 ft. x 2 ft. 2 in. x 4½ ft) were 6s. 8d. if within 4 miles of the forge, and 4s. 6d. if between 4 and 10 miles.³⁵⁶ The effect of distance on the price of cordwood for charcoal is also clearly illustrated on the Plymouth Estate (see p.272).

Production in the charcoal iron industry was typically intermittent. For example, at Clydach (Brecon) in 1704 the furnace was worked from September to January, the rest of the year being used to lay in stocks of raw material, particularly charcoal.³⁵⁷ At Merthyr, where the first furnace was built in 1765, the pattern was that 'work at the furnace should be carried on three days a week, and the other three be devoted to wood-cutting, which the men enjoyed immensely, especially as ... they combined it with snaring game, shooting blackcock ...'³⁵⁸ Cwmdwyfran forge (Carmarthenshire) closed down during slack periods and skilled men were put on to

other jobs which, early in the 19th century, included tree-planting, felling, and fencing of woodlands.³⁵⁹

Charcoal was produced close to where the wood was felled, because charcoal was always cheaper and easier to transport than wood. The charcoal-burners were known as colliers or wood-colliers (Welsh colier coed). The charcoal was made by stacking the mixed hardwood billets to form a regular conical mound, with a central vent for firing, and covering the mound with turves or earth laid on hurdles. The cordwood and charcoal agreements often included the purchase of sufficient rods and poles to make the hurdles, and also the cabins where the charcoal-burners lived during their work in the woods. The charcoal sites were called pits or hearths (Welsh holo cols or aelwyd cols). Sometimes rectangular heaps were made, as much as 15 x 7 yards in size.³⁶⁰ On steep slopes, a platform would be made by cut and fill to form a level surface for the charcoal burning operations. These platforms can still be traced in many of the valleys of south Wales, the soil of the platform being black and impregnated with charcoal dust to a depth of ca. 1 foot*. Burning usually took 10-12 days. The charcoal was raked out, and after cooling it was bagged. Small or broken charcoal, called braise, was of inferior value and bagged separately.

As demand grew, a class of middle-men arose to negotiate the purchase of woods and the delivery of charcoal, contracts being based on the costs of transport and the quality of the charcoal supplied. Transport was generally by trains of pack-horses or pack-mules, carrying sacks or panniers of

*Field excavations at Garth Maelwg (Glam.), Nov. 1977.

charcoal for distances of up to 12-15 miles, but occasionally for as far as 25 miles, e.g. at Dolobran forge (Montgomeryshire) in the 1720s.³⁶¹ At Margam (Glamorgan) in the mid 18th century, indentures stipulated that horses carrying charcoal should be muzzled^{*} in such a manner that they could not browse the young growth in the woods.³⁶² Sacks for charcoal were usually made up locally, from canvas or sacking stitched with twine and tied with cord. At Monmouth a standard sack held $1\frac{1}{2}$ cwt.³⁶³

The agreements and contracts drawn up for felling and charcoal-burning operations gradually became tighter, in order to protect the property. For example, at Dolgyn Ucha (Merioneth) in 1733 the purchaser agreed to buy all trees, underwoods bushes etc. 'excepting such Oak, Ash and Elms as are already marked and appointed ... to stand and be preserved'. Bark was included in the sale, and also rights of ingress, egress, and regress for agents and workmen; liberty to dig pits and turf necessary for making charcoal (doing in all this as little damage as possible on the premises). All trees, cordwood, bark and charcoal was to be cleared by a specified date.³⁶⁴

In the smelting of lead, charcoal (often called 'black coal') was used in mixture with 'white coal', i.e. wood chopped or slit into small pieces and dried in a kiln; the 'white coal' was sometimes called 'gads' or faggot-wood. 'Black' and 'white coal' were usually mixed because charcoal alone made too violent a fire, and wood alone was too gentle.

*Muzzling of draught animals was also specified in a large timber sale at Golden Grove (Carmarthenshire) in 1757 (Carmarthen Record Office, MS. Derwydd D 180)

This mixture was quite generally used in Wales, e.g. at Ynys-hir (Cardiganshire)³⁶⁵ and at Mold (Flintshire).³⁶⁶

The demand for charcoal in the iron-industry in Wales led to several celebrated legal cases that illustrate the scale of the felling and coaling operations, viz. the Penrhos Common case, the Wentwood case, and the Hanbury osmond iron case.

In the Penrhos Common case, English speculators built an iron-works in the Ganllwyd valley (Merioneth) and bought their wood supply from Hugh Nanney, a local land-owner. However, the oak sold by Nanney came from Penrhos Common which was Crown land lying within the Forest of Snowdon. Nanney was accused in the Court of the Star Chamber of felling and converting to his own use 30,000 oak trees, valued at 3s. each, between 1588 and 1603. He was fined £1500 (later reduced to £800). The felling was done by local labourers, one of whom deposed that he was hired for a day's felling at piece-work rates, viz. $\frac{1}{2}$ d. per tree, and that in the day he felled 28 oaks 'not choosing the lesser oaks to be Cutt but taking them as they hapened to be next to hym'.³⁶⁷

In the Osmond iron controversy, large areas of woods in Monmouthshire were engrossed, forestalled and bought up by entrepreneurs to ensure continuity of charcoal supplies for the manufacture of 'merchant' iron (i.e. bar iron). These activities adversely affected the crown interests in the manufacture of osmond iron for wire-making. Richard Hanbury is alleged to have wrongfully converted to his own use 38,000 cords of wood and 500 loads of charcoal to make merchant iron.

Glascoed Wood (660 acres) was acquired from the Earl of Pembroke, and over 6000 beech timber-trees '1 ft. square at stub' were felled in Glascoed Wood and the woods of Glyntrosnant, Wentwood, Wernhir etc. for charcoal.³⁶⁸

The Wentwood case involved the enclosure of 3000 acres of Wentwood Forest (Monmouthshire) by the Earl of Worcester in ca. 1630, and later (in 1678) the felling, cording, coaling and removal by the Marquis of Worcester of wood alleged to be worth £60,000. The tenants who held rights in the forest valued their privileges highly and resisted the encroachment. They were prosecuted by the Marquis in a case that finally went to the House of Lords. The eventual outcome was that a large part of Wentwood was taken out of the forest.³⁶⁹

Charcoal-burning operations have given rise to many place-names throughout Wales, viz. names containing the elements golosg (=charcoal), gloddaith (= charcoal pit), cols (= charcoal or coal), and glo (= charcoal or coal); for example, Cefn Golosg (two examples in Cardiganshire), Golosged Du (Carmarthenshire), and Gloddaith (Caernarvonshire). In areas where coal does not occur, glo can be taken to indicate charcoal, as e.g. Cwm-y-glo (Llanrug, Caernarvonshire).³⁷⁰

At the end of the 18th century, following technical advances on the continent of Europe, trials began in Britain on the distillation of wood in metal kilns or retorts, to produce charcoal and by-products such as pyroligneous acid (crude wood vinegar) and wood-tar. The development of the wood distillation industry or 'steweries' in the Forest of Dean

has been described by Hart.³⁷¹ This method of manufacturing charcoal spread rapidly in Wales during the 19th century, especially in the industrial regions of the south and north-east. Wood chemical works or wood distilleries accounted for an increasing proportion of charcoal production, and the traditional method of charcoal burning in pits or mounds correspondingly declined.

A wood chemical works at Hope (Flintshire) was in operation before 1810, supplying pyroligneous acid for the use of local cotton-dyers,³⁷² and the Melincryddan Chemical Works (Neath, Glamorgan) started in 1797 and supplied charcoal and acid to local iron and tinplate works during the 19th century.³⁷³ The Melincryddan Chemical Co. was the most important regular purchaser of cordwood, mainly oak, from the local Gnoll estate during the 19th century; in the 1850s, cordwood prices for these works were in the region of 13s. 6d. per ton, depending on species and quality.³⁷⁴ The Stradey estate (Carmarthenshire) sold cordwood to the chemical works at Llanelli, e.g. elm cordwood sold at about 10s. per ton in 1878-1883.³⁷⁵ Even estates in remote rural areas found outlets for low-grade hardwood cordwood in the chemical works; the Hafod estate (Cardiganshire) was selling third-quality beech, birch and sycamore to chemical works (? in Aberystwyth) at prices of 4-6s. per ton in 1869.³⁷⁶ The Brechfa wood-chemical works in Carmarthenshire operated on local woodland produce to manufacture charcoal and other products in the late 19th century.³⁷⁷

The cordwood was extracted in pack-loads by mules and horses, and the economics of transport dictated that only a small 'catchment' area around each works could be used for cordwood supply. In the county of Glamorgan alone, 13 different chemical works were in operation in 1874.³⁷⁸ However, the traditional method of charcoal-burning persisted in places in Wales until about the end of the 19th century. For example, at Penrhyn Castle (Caernarvonshire) the head-forester, Angus Webster, preferred and used the traditional method of charcoal burning in the 1880s, believing that it produced charcoal of better quality, though acknowledging that charcoal could be manufactured more cheaply in retorts.³⁷⁹

(ii) Ship-timber

Another major industrial forest product was wood for shipbuilding, both for merchant ships and especially for the navy. The importance of home-grown timber, especially oak, for the navy has been described by Albion,³⁸⁰ who gave details of the supply and demand situation for naval timber from 1652 to 1862 with particular reference to the Crown forests of England. Special studies of the role of the Forest of Dean in the supply of navy timber have been made by Hart.³⁸¹ Demand for shipbuilding timber was always steady, but in crisis periods it increased greatly e.g. during the Commonwealth, in the Seven Years' War (1756-63) and in the Napoleonic Wars (ca. 1798-1810). Oak was the main species required, in straight pieces and also special curved and angled assortments with natural bends. Straight timber was obtained from forest-grown oak, whereas more of the particular naval assortments requiring natural bends were obtained from open-grown hedgerow and park trees than from forest trees. Oak forest trees, if not cut on a short coppice rotation, were normally felled at 80-120 years (at 15-18 inches diameter), i.e. too early to produce the large special curved pieces required by the navy. The navy also bought home-grown elm and ash and, in later years, it acquired timber of a variety of species from the Baltic, North America and the Far East.

Hammersley has shown that Albion's assessment of the scale of fellings and the critical supply position in

the 16th and 17th century was exaggerated,³⁸² and Rackham argues that there is no hard evidence that the shipbuilding industry was ever seriously in difficulty over timber supplies.³⁸³ Because of incompetence and corruption, the Crown forests were incapable of supplying the amounts required, and most naval timber was bought from private estates. The Navy was prepared to pay good prices for select timber but its price policy was inflexible. It was not economically very attractive to grow oak on long enough to produce the large and special assortments required for shipbuilding, and the temptations to fell earlier were considerable. The Navy Board operated a contract system for the supply of wood, and purveyors inspected the trees felled on contract. Standard contracts specified prices for straight oak timber, compass oak timber (special crooked and curved pieces), oak knees (curved or angled pieces), thickstuff (planking over 4 inches thick), oak planks (various thicknesses up to 4 inches), and also elm and ash timber. Extra prices were offered for winter-felled material, but winter-felling was against the interests of the tanbark industry (cf. p.174).

A typical example of a naval timber contract is that between the Navy Commissioners and Trevor Nicholas, timber merchant of Chepstow, signed on 9th April 1789.³⁸⁴ Nicholas contracted to supply by a specified date a total of 437 loads* of straight and compass oak timber, thickstuff

* a load = 50 cubic ft.

(5½-inch plank), square and raking knees, elm timber, and 3- and 4-inch oak planking, all of specified cubic contents, lengths and square top-end dimensions, grown in Monmouthshire and Herefordshire. In addition, Nicholas contracted to supply 14,000 dry seasoned oak treenails (wooden pegs used in shipbuilding) of various sizes from 12 to 36 inches long, cut out of 'young, clung, tough coppice timber'. The contract contained an additional clause allowing for extra payment per load above a certain figure for the expense of the long-distance carriage to Plymouth. An extra payment of £7 5s. was made per £100 of material for any winter-felled timber, i.e. certified and marked by the purveyor as being felled with the bark on between 1st December and 15th February.

Land transport of large assortments always presented considerable difficulties, and rivers were used for loose floating, rafting or transport by ship wherever possible. Large logs were moved to the water on wagons by teams of horses or oxen, but in mountainous country the timber had to be pit-sawn at stump to boards or planks which were carried out on horse-back. River transport of timber has been recorded on the Severn, Wye, Neath, Towy, Teifi, Dyfi and Conwy, and was doubtless practised wherever feasible on all the major rivers in Wales.

There is little evidence to show that Welsh woodlands supplied much naval timber in the 16th century, and Albion dismissed the Welsh contribution as: 'Wales grew good oak

of small dimensions; but much of it was inaccessible, and the Navy did not utilize it to any extent until after the Seven Years' War'.³⁸⁵ However, not all the Welsh oak was small (cf. pp. 167-8), and well before the Seven Years' War the growing demand and a contracting resource had resulted in increased utilization of Welsh oak for shipbuilding, despite the long transport distances to the major dockyards.

The accounts for the Gwydyr estate woods in the 1680s are available.³⁸⁶ Analysis of these accounts indicates that a systematic programme of felling and conversion was in force to produce sawn timber and dimension stock to meet regular orders. The wood was converted on the estate by pit-sawing, and was sold usually one or more years after felling. Some timber was floated down the river Conway to coastal vessels. Large and regular sales of shipbuilding assortments, e.g. 1½- and 2-inch oak planks, were made from Gwydyr to Liverpool shipwrights. Small local ship-builders were also supplied. In addition to the regular felling programme, the Gwydyr estate also made casual sales standing and salvage sales.³⁸⁷

Ships were sometimes actually built in the woods, i.e. at stump where the wood was pit-sawn and shaped. In his autobiography, Twm o'r Nant gives an example of a vessel of 30-40 tons burden that was built in the woods 1¼ miles from the river Towy near Abermarlais (Carmarthenshire) in the 1780s.³⁸⁸ Local enterprises building small merchant vessels operated all around the coast of Wales, using at first exclusively home-grown oak but later, and especially in the 19th century, timber imported from North America. Some

naval shipbuilding was also done in Wales, e.g. in 1763 a 74-gun ship was being built at Neyland (Pembrokeshire) but the local woods could not supply the timber for it because in the words of a shipwright 'so effectually is this county stript of navy timber that we are not able to purchase so much as a futtock^{*} to put in her'.³⁸⁹

In the 18th century, Welsh woods became increasingly important as sources of supply of naval oak. For example, in 1746 Lord Mansel (of Margam) concluded a standard contract with the Navy Commissioners for 506 loads of straight oak timber, 1056 loads of compass timber, 63 loads of square and raking knees, 63 loads of oak plank 3 and 4 inches thick, 79 loads of elm timber, and 50 loads of ash timber, i.e. a total of 90,850 cu.ft.³⁹⁰ Even in Montgomeryshire, distant from the naval dockyards, fellings of navy oak took place, e.g. at Lymore Wood in the 1660s,³⁹¹ and throughout the 18th century, e.g. at Abertanat Wood (ca. 1730), Leighton (1742), and Powys Castle Park, Abernant and Trefedryd (ca. 1750).³⁹² Intense competition between buyers occurred ca. 1770, forcing oak prices above those even of Monmouthshire oak. Other important fellings of navy oak in Montgomeryshire occurred at Vaenor Park (1793, 1796), and the dimensions of some of these trees are known: one oak measured 68 inches in girth at a height of 73 feet; 26 of the largest trees totalled 37,772 cu.ft.

^{*} futtock = a slightly curved middle timber of a ship.

(average 1452.5 cu.ft. per tree); the largest tree was measured at 2501 cu.ft.³⁹³ The felling and conversion of very large oaks for naval timber was a laborious business, as illustrated by the example of the Golynos oak in Monmouthshire, which was 9ft. 6in. in diameter and contained 2426 cu.ft. of timber.³⁹⁴ When it was sold in 1810, five men were employed for 20 days stripping off the small branches to form a cushion, cutting down the valuable main branches from specially erected staging, and finally felling the stem with two cross-cut saws brazed together. Two sawyers were then employed for 138 days in conversion, the main stem being cut into quarter boards and cooper's stuff, and the branches making naval timber assortments, viz. 3 upper piece stems, 6 futtocks, 1 floor timber and about 20 knees, all suitable for ships of the line.

The Seven Years' War was a period of particularly high demand for naval oak, and in the period from 1754 to 1760 over £50,000 worth of forest oak was cut on the Gwydyr estate and floated down the Conway.³⁹⁵ The War caused a general shortage of naval oak timber throughout England and Wales. The extent of the problem can be gauged from a survey of people knowledgeable in the timber trade in Wales, made by a Liverpool shipwright named Fisher, in the early 1760s. Fisher's account is summarized below:

If from Liverpool we trace the coast of Wales through Flintshire, Denbighshire and Caernarvonshire, counties which have been extremely well stocked with timber, and are at present part of the magazines for Liverpool, and the North ... we shall find them much exhausted. If we proceed to Merionethshire, this county has been much drained of her timber ... In Cardiganshire and Pembroke we find very little timber ... From hence we proceed to Caermarthenshire and Glamorganshire, where very little timber is remaining ... We come now to the great rivers, Severn and Wye, by whose streams the flourishing city of Bristol, and his Majesty's Yard of Plymouth have been long supplied. These are the grand magazines for almost half the nation, and take in the counties of Monmouth, Hereford, Shropshire, Montgomery, Radnor and Brecknock ... And I am not only particularly acquainted with most of these counties; but likewise with the universal complaint of the timber merchants residing in them, of the scarcity of full grown timber, and the neglect of planting.³⁹⁶

Accordingly, every county in Wales was specifically named as suffering from a shortage of naval oak timber, except for Anglesey which was ignored completely as it had not for centuries been important as a source of timber. The main reason for the shortage in nearly every case was stated to be the felling of wood to supply the furnaces and forges of the iron-works, coupled with lack of care in protecting coppices or neglect of planting:

it is become a custom for the iron-masters to purchase all large quantities of timber in North and South Wales; and the shipwrights and other artificers are laid under the obligation to purchase from this set of men whatever they shall think proper not to appropriate to the use of their furnaces.³⁹⁷

Fisher's account is merely one of the recurring forebodings of crisis in supplies of naval oak by private interests and by government over a period of at least two centuries. In May 1771 Fisher gave evidence to a committee of the House of Commons appointed to consider how the navy might be better supplied with timber. He stated that the Navy Board had recently bought some large parcels of timber in Denbighshire, and that timber was available in Montgomeryshire, though he doubted, from personal experience, whether it was worth removing because of the expense of carriage to the Plymouth yard.³⁹⁸

Again in 1791 an official inquiry was instituted by the government into the resources of naval timber by means of a detailed 17-point questionnaire survey organized on a county basis.³⁹⁹ The answers from the Welsh counties may be summarized as follows: in recent years the quantity of large oak timber fit for the navy had diminished, often considerably; the growth of oak trees in hedges was not encouraged; overcutting was general ('there are Ten Fellers for One Planter, and Ten Planters for One Preserver, of Oak Timber' - Radnor); oak prices had risen; more land had been cleared than had been planted with oak; and few plantations of oak or other trees fit for the navy had been made.

Though proximity to navigable water was important in determining the accessibility and merchantability of

naval oak, in the 18th and 19th centuries improvements in roads and the building of canals made more oak accessible. For example, in 1804 a total of 1157 oak timber trees in the parishes of Llantrisant and Llanwonno (Glamorgan) were advertised for sale in London and Swansea papers in the following terms:

The above timber is of the best quality, and fit for the Naval Engineer and other purposes that require timber of the largest dimensions, is situated within from one quarter or three miles of the turnpike road and canal to Merthir and a part of Cardiff⁴⁰⁰

Similar wording stressing proximity to an excellent turnpike road, the Montgomeryshire canal and the river Severn was used to advertise the sale of 183 large oaks 'calculated for the Navy' in Montgomeryshire in 1808.⁴⁰¹ Again, when a total of 7347 scribe-marked or paint-marked oak trees in the parishes of Llanfairarybryn, Cilycwm, St. Mary's Kidwelly and Cenarth (Carmarthenshire) were auctioned in March 1821, most of the timber was advertised as 'fit for ship building' and being situated within a short distance of the river Towy or contiguous to the turnpike road.⁴⁰²

Accordingly, it may be concluded that from the 17th to the mid 19th century, naval oak represented a welcome and reliable market for Welsh owners. Demand for precisely specified assortments was fairly steady,

with recurring peaks of particularly high demand,
and in the traditionally better wooded counties
(e.g. Monmouth, Montgomery, Glamorgan and Carmarthen)
considerable supplies of suitable oak continued to
be available throughout the period.

(iii) Tanbark

Oak bark for the leather tanning industry had represented an important forest product since medieval times (cf. p.93), and bark continued to be a valuable by-product until the end of the 19th century. The demand for bark was constant but bark was always a secondary product, dependent on other industries involving utilization of the wood, e.g. for charcoal, pitwood or shipbuilding timber.

Bark is easiest to harvest in the spring, when the sap-flow makes stripping easy. Accordingly the tanbark harvest was highly seasonal and also dependent on other industries, and supply was therefore relatively inelastic. The market was also local and fragmented. The best tanbark came from coppice oak 25-30 years old, but bark was harvested from any oak, including large old timber trees and windthrown trees. In the 19th century, bark was occasionally harvested from birch, larch and even from beech but, in general, species other than oak were unimportant.⁴⁰³

Although the bark harvest was mainly seasonal (spring), tanneries needed to secure supplies for ~~a~~ year's working. The market situation invited attempts to buy up bark and secure a monopoly, and laws against forestalling were passed, e.g. by James I in 1603.⁴⁰⁴

Bark was harvested in two ways, viz. from standing trees and from felled trees. The former method involved working

from ladders but meant that the bark could be peeled off right round the stem in one piece; peeling of standing trees was usually practised on smaller stems which were felled later. The second method involved barking the stems and larger branches on the ground, but it was difficult to peel off all the bark without rolling the stem. Sometimes a combination of the two methods was practised, by 'butting' the stem, i.e. peeling it for a certain height before felling, and then completing the bark stripping on the ground.⁴⁰⁵ The harvesting tools and techniques were simple and remained basically unchanged until the end of commercial bark harvesting, i.e. a light axe or heavy knife to score the bark, a hammer, and large and small peeling irons (ranging in size from small crowbars to spoons) to lever the bark off.

Fellings were often deliberately timed to take advantage of the spring sap-flow from April to June, when the bark was easiest to strip. An indenture regarding felling for charcoal for the forge at Aberafan (Glamorgan) in 1759, for example, stipulated that the felling was to be done at the proper time for stripping.⁴⁰⁶ However, buyers of construction timber traditionally demanded winter-felled oak, and the navy offered higher prices for winter-felled material (cf. p. 165), and this naturally conflicted with the interests of the tanbark industry.

Bark harvesting formed a major seasonal work peak in the spring, and there were two different methods of

organizing the harvest: (i) harvesting the bark with estate staff plus temporary casual labour, and then selling the bark direct; and (ii) selling the bark on the tree, the buyer being responsible for stripping. In the second method the buyer might be the tanner, or a middleman contractor. The two different methods were often used on the same estate. For example, the Gwydyr woods accounts for the 1680s show that complete stacks of harvested bark were sold direct to a tanner for a lump sum of £28, and that other tanners bought the bark of 66 trees at 14d. per tree, stripping the bark at their own expense.⁴⁰⁷ Women and children were extensively employed in the bark harvest in all parts of Wales, right up to the end of the 19th century.⁴⁰⁸

Once peeled, the bark was kept dry, either by stacking it on racks in the woods, or by moving it to a more secure place, e.g. a barn or even to special stone-built bark-houses. Clean dry sound bark brought the best prices. Green bark, wet bark, old mossy bark or damaged bark was less valuable.

Bark yields varied widely according to stand age and density, being generally about 1 ton of bark for every 3-5 tons of wood. One old tree felled in Monmouthshire in about 1804 produced 3 tons 17 cwt. 2 qrs. of bark.⁴⁰⁹ In general, 4-5 lb. of bark were needed to make 1 lb. of leather. Bark was sold by the bundle, by the load,

by the yard, by the tree, and by the acre, but more generally and especially in later years by the ton.

Prices are difficult to compare because of the problems in determining the precise dimensions of the units of sale, but the overall picture for England and Wales is that bark prices were fairly stable from ca. 1660 to 1780 at about £2 per ton; they increased to ca. £4 to £6 per ton by 1790, and then rose quite dramatically during the next twenty years to reach £16 and even more per ton; after the Napoleonic Wars, prices declined again and by 1850 had fallen to the levels of ca. 1790.⁴¹⁰ The pattern in Scotland was identical.⁴¹¹ The highest bark prices recorded in Wales seem to have been £14 per ton in 1809 and 1810, e.g. £14 per ton 'in the rough' at Corsygedol Estate (Merioneth) in 1809, and £14 per ton in Monmouthshire and Montgomeryshire.⁴¹²

A coppice oak felling at 25-30 years ensured virtually complete utilization of the stand by local industries, the poles being used for props in the local collieries, the cordwood being used for charcoal-burning for local ironworks, and the bark being used at the local tannery. However, in addition to satisfying the needs of local tanneries throughout Wales, fellings in Welsh oak woods were still sufficiently extensive in the 18th and early 19th centuries to support a substantial bark export trade to Ireland and to cities in England, e.g. Bristol and Liverpool. In the 18th century, oak bark was exported from many small ports in Wales, e.g.

Neath, Milford, Aberdyfi, and Cardiff.⁴¹³ Table 17 shows exports of bark from Cardiff to Ireland in the mid 18th century.

Table 17. Exports of oak bark from Cardiff to Ireland, 1727-1767.⁴¹⁴

Year	Bark exported tons	Year	Bark exported tons
1727	46	1753	40
1728	97	1754	14
1729	50	1755	15
1730	55	1756	35
1734	12	1757	139
1735	64	1758	152
1736	94	1759	68
1737	20	1760	65
1738	35	1761	81
1740	85	1762	32
1741	34	1763	61
1742	48	1764	170
1746	35	1765	145
1747	40	1766	104
1749	23	1767	42

Table 17 shows a steady export trade of oak bark from South Wales to Ireland (chiefly Dublin and Waterford). The shipments were generally of the order of 20 tons each. Sometimes the bark shipped was described as 'chopped'.

However, the main centre for bark export was Chepstow, the bark coming from the forests on the Welsh and English sides of the Wye. Some idea of the growth of the oak bark export trade from Chepstow can be obtained from Table 18.

Table 18. Bark exports from Chepstow for selected years in the 18th century.⁴¹⁵

Year	Bark exports (to nearest ton)	Year	Bark exports (to nearest ton)
1714	48	1793	3839
1715	270	1794	4339
1718	735	1795	3814
1719	488	1796	5200
1791	4028	1797	3914
1792	4766	1799	>9000

The pattern of the bark export industry via the Wye was as follows. Bark was stripped in the woods and carted to the riverside, where gangs of women cleaned off any moss with long knives. The bark was then cut up into pieces and held in riverside bark-houses to await transport. The bark was loaded into barges capable of carrying up to 20-25 tons of bark, and moved down-river to the warehouses at Chepstow for eventual export.⁴¹⁶ The occupations associated with the Chepstow bark trade are self-explanatory: bark-strippers, bark-choppers, bark-cleaners and bark-carriers.

The demand for bark decreased generally during the 19th century; for instance, the Chepstow bark export trade declined after ca. 1820, and came to an end in ca. 1883.⁴¹⁷ Prices for bark for local tanneries in Wales remained at about £4 or £5 per ton to the end of the 19th century, as shown e.g. by the Plymouth estate accounts (cf. pp. 274-5) and by the Bark Account Books for 1876-1887 for the Rhayader Tannery, the last oak-bark tannery in Wales which continued

to operate until the early 1950s.⁴¹⁸

The former widespread importance of the oak-bark industry in Wales can be traced to a certain extent by place-name evidence, viz. many names containing the noun element rhig(l) (= bark) and the adjective rhig(l)og; for example, Blaen Rhiglog, Nant Rhiglog, Gwern Rhiglog, Cwm Rhiglog, Tŷ Rhigl, Hafod y Rhigl, Risca (Rhiga), etc.⁴¹⁹

(iv) Pitwood

Besides charcoal, ship-timber and bark, the other major industrial forest product from Welsh woods was pitwood of various types. From the earliest times, all mining operations, whether for metalliferous ores or for coal, had required substantial amounts of wood, not only to make charcoal for smelting, and for use below ground in connection with the actual mining operations, i.e. for roof and wall supports, but also for ancillary works on the surface, i.e. for mine buildings, sluices, etc.

Though mining for metals was locally important in many parts of Wales over many centuries, coal was restricted to the two major coalfields of South Wales and North-East Wales, and was relatively unimportant until the 16th and 17th centuries.⁴²⁰ Coal was little used in Wales for domestic heating until the 17th century; thereafter it was increasingly used in towns, but wood and peat remained the preferred and major fuels in many rural parts of the country until the 19th century. For example, in Montgomeryshire 'the fuel of a great part of the county consisted almost entirely of the best cleft timber' until towards the middle of the 18th century,⁴²¹ when large-scale utilization of oak for navy timber began (cf. p.167). Following the pioneering work of Abraham Darby (1666-1718), the use of coke and coal in place of charcoal for smelting heralded the beginning of the decline in the production of charcoal as a major forest product, but it simultaneously launched the great expansion of coal-mining in Wales, and with it a vast increase in demand for

pitwood. From the mid 18th century onwards, coal increasingly replaced wood, peat and charcoal as fuel, thus affecting the market for fuelwood but creating its own demand for other forest products in the form of various categories of pitwood. By 1812 in Monmouthshire the use of coke from pit-coal had caused the price of cordwood for charcoal to remain stationary or nearly so, while the price of timber had risen 3- or 4-fold.⁴²²

Before softwoods became generally available for pitwood at the end of the 18th and during the 19th century, all the pitwood used in the coalfields in Wales was hardwood, most of it acquired from local woods or from woods in other parts of Wales. The Welsh woodlands were mixed hardwoods with a preponderance of oak, and the composition of the pitwood used underground reflected this. Little attention seems to have been paid to species, though the bulk of the pitwood used was oak.

Most of the pitwood used underground was used in the round, and trimmed to shape as necessary by axe. The two main types of hardwood pitwood material required were (i) pole-lengths of roundwood to make posts, props, arms and collars, and (ii) shorter corded material to make cogs or cogwood, i.e. short billets or blocks that were built up to support the roof. These two categories of material could be produced by thinnings or, more generally, by coppice fellings. With the later development of the coalmining industry, sawn or dressed timber was used for

special purposes such as the lining of shafts. In this connection it should be remembered that Britain as a whole was very slow to adopt mechanical sawing in sawmills, even though they were extensively used in Europe and New England in the 17th century. In Wales the framed pit-saw and later the open pit-saw remained in more general use until well into the 19th century. Continuous-action water-powered saws (circular and band saws) did not become common until the 19th century.⁴²³

It was important for pit-owners to secure adequate supplies of suitable pitwood, and whole woods were bought for the purpose. For example, in 1713 in Pembrokeshire, 7 acres of 'fine wood ... which the colliers say is the best they ever saw for that use' were bought at £40 an acre for the use of Cartmakers' Pool coalpits.⁴²⁴ In the 18th century the main demand for hardwood pitwood was in the form of barked oak roundwood (poles), and forest management was directed to this, mainly by simple coppice (rather than coppice-with-standards) on a rotation of 20 to 30 years. An account of Llanbadarn Fawr (Cardiganshire) in 1755 stated that 'there are no quantities of large timber, the mine-works destroying them all, but oakwood of 20 or 30 years growth are sold at about 6d a foot'.⁴²⁵ The typical management of coppice oak woods in Pembrokeshire in the 18th century is known in detail: the coppice shoots on the stools were thinned out ('waste weeding') at 3-4 years so as to leave 4-6 of the most vigorous

shoots per stool; 5 years later a heavy thinning called a 'cordwood weeding' was done, the produce being used for making charcoal; then about 15 years later (i.e. at about 23-25 years) the 'coppice of poles' was fit to cut for the use of the collieries and the final clear felling was made. The poles were sold at about 7s. 6d. per dozen (bark and cordwood included). The bark was stripped off and sold to local tanneries or exported, e.g. to Ireland or Scotland. The report adds that 'whilst the collieries have occasion for such vast supplies of small wood, to support their underground ways, it is not likely that the woods will be suffered to grow to timber for husbandry and building uses'.⁴²⁶ Dominated by the market for coalpit timber and also for cordwood for charcoal, the management of coppice oak was on similar lines throughout South Wales. Early in the 19th century sapling oak poles for the collieries were selling for about 8s. to 12s. per dozen, according to size.⁴²⁷ Indeed, the demand for pitwood in South Wales was so great that oak woods in North Wales were managed for this special market, and the poles shipped to the south. The port records of Aberdyfi, for example, show that in 1791-1794 over 27,000 'British oak poles' were exported, mainly to Milford Haven (Pembrokeshire).⁴²⁸ The poles were sold and recorded in the port accounts in dozens.

Besides poles, the smaller material needed in pits was prepared and sold by the cord, using cordwood measures

adapted from the charcoal industry (cf. p.155). For example, a lease relating to a coal work at Aberavon (Glamorgan) in 1746 specified a payment of 10s. for 'every Long Cord of Coal pitt Wood or Timber The Measure thereof to be adjusted and Ascertained according to the usual way or Method of Measuring the Long Cord of Wood for Charcoales now used in the Sd County of Glamorgan Allowing Breadth for Length'.⁴²⁹

Pitwood was generally extracted by teams of horses or mules equipped with slings or cradles. For example, in about 1800 in the neighbourhood of Pontypool (Monmouthshire), iron frames 'like the horns of an ox' were fixed on the pack-saddles of horses, each horse carrying 5 or 6 logs 10-12 ft. long and 8-9 inches in diameter, lying lengthways on the animal.⁴³⁰ A similar method was still being used 120 years later, for extraction of European larch pitwood near Crickhowel (Brecon): poles cut to 6-ft. lengths and down to 2 in. top diameter were loaded into slings or pannier cradles attached to the saddles of mules; each mule carried about 4 cwt., the extraction being done on contract by mule-drivers each of whom had up to 6 mules working under his guidance.⁴³¹ Mixed hardwood pitwood (sprags, cogwood, and poles) was extracted by mule-teams with wooden cradles and leather straps from the woods above Tongwynlais to the railway at Taff's Well (Glamorgan) as

late as the 1920s.⁴³²

Welsh estates, some with their own mining interests, sold large amounts of pitwood throughout the 19th century. The pitwood consisted of hardwoods and softwoods, particularly larch. The dominant role of the pitwood market can be seen from the detailed analysis of wood sales on the Glamorgan portion of the Plymouth estate (cf. Table 35 and p.272). Various units were used for sales of pitwood, as pitwood was sold by volume, by number, by weight, by stacked measure, and by length. At Hafod (Cardiganshire) in 1857 larch pitprops above $4\frac{1}{4}$ inches in girth were sold by the cubic foot at 10d. per cube; smaller props were sold by the dozen, e.g. larch poles 25 ft. long at 6s. 6d. per dozen; in 1869, oak pitprops sold for 3d. each and larch pitprops for 4d.-6d. each.⁴³³ In 1878-83, the Stradey estate (Carmarthenshire) sold larch, oak and elm pitwood at 28s. per ton.⁴³⁴ On the Plymouth estate (Glamorgan) pitwood was sold by the cord, at prices ranging from 12 to 40 s. per cord (see below, p.272). In some places, pitprops were sold by the yard, e.g. at $1\frac{1}{2}$ -3d. per lineal yard.⁴³⁵

However, the home-grown contribution was inadequate in quantity and in quality to meet the demands of the rapidly expanding coal industry. Imports of coniferous pitwood into Wales started at least as early as 1775, for in that year the firm of John Howells (Steam Saw-Mills, West Dock, Cardiff) was engaged in importing 'Norway mining poles or

pit-props'.⁴³⁶ Norway and the Baltic states provided considerable amounts of pitwood, but as the business built up rapidly in the second half of the 19th century with the advent of Free Trade, the bulk of the coniferous pitwood imports came in from south-west France, Spain and Portugal. In 1882, imports of pitwood and sleepers into Cardiff alone were 226,175 tons, and the local supply was said to be 'insignificant'.⁴³⁷ In each of the 10 years before 1914, pitwood and pit-prop imports into Cardiff, Newport and Swansea were more than $1\frac{1}{4}$ million loads (i.e. some $\frac{1}{2}$ million tons per annum), and in 1913 the record figure of 1,641,952 loads was reached.⁴³⁸

Welsh estates were still able to supply large amounts of home-grown pitwood during the First World War. In 1919 the Monmouthshire & South Wales Coal Owners' Association awarded a gold medal to the Earl of Lisburne (Crosswood estate, Cardiganshire) for the best contribution to pitwood supplies during the war. Out of a total woodland area of just over 2000 acres on this estate, 1119 acres of pitwood were actually cut, and a further 136 acres were sold but not cut; the only pitwood remaining on the estate at the end of the war was 25 acres of larch. The estate's total yield of pitwood had been ca. 50,000 tons, or approximately $1\frac{1}{2}$ million cubic feet.⁴³⁹

CHAPTER V

THE EIGHTEENTH AND NINETEENTH CENTURIES

1. Private estate forestry
 2. Forestry on the Plymouth Estate (Glamorgan)
 3. Development towards a State Forest Service
-

1. Private Forestry

The influence of Evelyn and the legislation of the 17th century had exerted comparatively little effect in promoting forestry in Wales, though some planting of ornamentals and exotics had taken place, and commercial hardwoods had been established by direct sowing and by planting.

During the course of the 18th century, a succession of acts were passed by the central government designed to stimulate the development and utilization of the forest resources of the American colonies, and also to promote planting and the protection and preservation of woods and plantations in Britain itself. These acts have been reviewed and extensively cited e.g. by Robinson⁴⁴⁰ and later by Nisbet⁴⁴¹, and here it will be sufficient merely to list the main acts affecting woods in England and Wales (Table 19). In addition to these general acts, between 1714 and 1901 a total of 179 individual acts of parliament were passed for the enclosure of individual commons in every county in Wales, and in at least some cases the purpose of enclosure included planting.⁴⁴²

As Table 19 shows, the legislation relating to forests remained extremely severe during the 18th century. The Black Act (1723) decreed the death penalty for a number of offences in royal forests or chases, including cutting

Table 19. Important forest legislation in the 18th century

<u>Year</u>	<u>Brief outline of main features or purpose of the Act</u>
1714/5 (1 Geo. I)	encouraging the planting and preservation of timber trees, fruit trees and other trees for ornament, shelter or profit (making parishes liable to owners for malicious damage to timber trees)
1719/20 (6 Geo.I)	amended and extended the above
1722/3 (9 Geo.I)	The Black Act, decreeing the death penalty for various offences in royal forests, including cutting down or destroying trees
1754/5 (28 Geo.II)	against burning in forests
1755/6 (29 Geo.II)	for agreed enclosure of waste lands for planting
1763/4 (4 Geo.III)	for seizure of any tools and implements used in unlawful cutting
1765/6 (6 Geo.III)	encouraging the cultivation and preservation of trees (defining as timber trees oak, beech, ash, elm, fir, chestnut and aspen); with an amendment to include also walnut, lime, cedar, sycamore and birch as timber trees
1772/3 (13 Geo.III)	amending the above to include also poplar, alder, larch, maple and hornbeam as timber trees.

down or otherwise destroying 'any trees planted in any avenue, or growing in any garden, orchard or plantation, for ornament, shelter or profit'. This act was enforced on many occasions through the 18th century and even as late as 1814, when an Essex labourer was hanged for cutting down an orchard.⁴⁴³

The legislation in the 18th century also clearly reflected the increasing importance of plantations, and the start of conifer plantations. The definition of timber trees had

hitherto been restricted to oak, ash, elm and beech; in 1766 the number of species covered was extended, and 'fir' and 'cedar' were included for the first time. In 1773 the definition of timber trees was further extended to embrace other species, including another conifer, viz. larch.

In this respect, legislation as usual tended to lag rather behind events. Even in Wales, commercial plantations of forest trees, including conifers, were made during the 18th century. Although the woods accounts of the Gwydyr estate in the 1680s had shown evidence of carefully organized forest management for commercial ends, there was no indication of plantations or of conifers (cf. p.166). However, shortly afterwards, some estates in Wales began to plant conifers, one of the first being Lord Mansel's estate at Margam (Glamorgan). In 1738 a survey was made of the woods and trees on the Margam estate by a 3-man team headed by the 'house carpenter', Edward Harris, who was in effect the estate's forester, having been 'solely entrusted with the care, management and inspection of the woods of the sd. Lord Mansel'. The survey recorded the weight (in tons) of all timber 'eight inches square and above now growing on the estate'⁴⁴⁴. The results of the survey are given in Table 20.

The identity of the fir (spelled 'ffirr' in the survey) is uncertain, but it was probably Scots pine. Most of the timber was classed as 'thriveing', i.e. young trees or trees approaching maturity. The pollards ('trees that have been from time to time Lopp't and Headed for severall uses') were

Table 20. Timber survey on Lord Mansel's Margam estate, 1738

Species	Standing timber, in tons			
	Thriving	Full-grown	Decaying	Pollards
Oak	12,449 $\frac{1}{4}$	482 $\frac{1}{2}$	22 $\frac{1}{2}$	1410 $\frac{3}{4}$
Ash	413 $\frac{1}{4}$	49 $\frac{1}{2}$	4	106 $\frac{3}{4}$
Elm	140 $\frac{1}{2}$	7	3	17 $\frac{3}{4}$
Sycamore	123 $\frac{1}{4}$	18 $\frac{1}{2}$	-	5 $\frac{1}{2}$
Walnut	5 $\frac{1}{4}$	-	-	-
Chestnut	15 $\frac{1}{4}$	-	-	-
Fir	7 $\frac{1}{2}$	-	-	-
Total	13,153 $\frac{1}{4}$	557 $\frac{1}{2}$	29 $\frac{1}{2}$	1540 $\frac{3}{4}$

mostly scattered in hedges and hedgerows of the estate.

The current prices of the various species of timber are given in Table 21.

Table 21. Prices of various species and categories of timber on the Margam estate, 1738, in shillings/ton.

Species	Thriving	Full-grown	Decaying	Pollard
Oak	20	16	15	12
Ash	18	18	10	10
Elm	18	18	10	10
Sycamore	18	18	-	10
Walnut	30	-	-	-
Chestnut	25	-	-	-
Fir	30	-	-	-

The table shows that the young softwood ('fir') was valued at 30 shillings per ton, the same as walnut and more than any of the other hardwoods. This is a striking indication of its rarity value.

Another list of trees on part of the Margam estate, undated but early in the 18th century, also includes fir.⁴⁴⁵

The full list is as follows:

lime	36	(7 very fine)
oak	872	(at least half will measure as timber and some very large)
ash	142	(generally small)
elm	95	(some 'pritty large & generally midling')
poplar	58	(for the most part well grown)
beech	117	(small, except about 20)
sycamore	14	(half large, the rest small)
fir	5	(& Do. small)
lignum vita	5	
horse chestnuts	5	
yew	1	

Pictorial evidence exists of the increasing planting of conifers on estates in Wales in this period, as ornamental plantings became semi-commercial. Large numbers of conifers were planted at Erddig House (Denbighshire) between 1715 and 1740: no conifers are shown on a plan of 1715, but an engraving by Badeslade in 1740 shows many conifers (? pine), large and small, planted in rows and avenues. An engraving of Neath Castle and the Gnoll House (Glamorgan) in 1741, by S. and N. Buck, shows rows of large conifers (? spruce).

The identity of the conifers planted is not always certain. They were usually called 'fir' and this could refer to Scots pine (Pinus sylvestris) or Norway spruce (Picea abies), or possibly even silver fir (Abies alba). Silver fir was planted in 1722 at Newport (Pemb)⁴⁴⁶. Sometimes the conifers were described more precisely, viz. Scotch or Scots fir (Pinus sylvestris)

and 'spruce fir' (Picea abies). For example, Arthur Young reported from the Vale of Towy (Carmarthenshire) on a tour in the 1770s that the locally grown spruce fir was 'very good; almost as white as Norway deals', and sold for 7d. per foot.⁴⁴⁷

On the Gogerddan estate (near Tal-y-bont, Cardiganshire) there was a large conifer plantation, apparently established in the middle of the 18th century. A traveller who saw the plantation in the mid 1770s described it as follows:

"a very extensive and flourishing plantation of firs, which covered the steep declivities of two hills ... Such an example deserves imitation, especially, in country where the soil and climate seem averse to the production of all other kinds of forest trees. But, notwithstanding the very thriving state of this plantation, the beauty of its appearance, and the certain profit attending it, I am sorry to add, that this was the only instance of such oeconomical cultivation which we saw in this part of our tour."⁴⁴⁸

In this account it is significant that the observer stressed the vigour, beauty and profitability of this large conifer plantation, and the suitability of Wales for such plantations, but also the fact that the plantation was a rare and unusual feature in the rural landscape.

The other European conifer that was planted in Wales in the 18th century was the larch (Larix decidua), the earliest known plantings of which were at Abercamlais and Penpont (Breconshire) in ca. 1740.⁴⁴⁹ However, although the conifers of Northern Europe were the only ones used in commercial plantations in Wales in the 18th century,

increasing interest was being shown in North American species. Newfoundland 'fir' had been introduced before 1600 (see p.132) and Virginian cedar in 1685 (see p.145), but later on, more extensive collections became possible. For example, William Morris acquired cones, seeds, and acorns from North America, and tried to grow them in his garden at Holyhead. On 16 May 1761 he wrote that he had sown about 50 different kinds of North American conifers and oaks.⁴⁵⁰ On Rhual estate (Flintshire), the planting in 1774 included small numbers of Black American Fir, Pinaster, Virginia Cedar, Newfoundland Pine and Balm of Gilead Fir, as well as larger amounts of Scotch Fir, Silver Fir and Larch.⁴⁵¹

However, casual acquisitions, gifts and exchanges of seeds and planting stock were clearly inadequate to sustain plantation establishment on any large scale. To meet this need, commercial forest nurseries were becoming established in England, Ireland and Scotland early in the 18th century,⁴⁵² but no forest nurseries were started in Wales until towards the end of the century. Accordingly, Welsh planters seeking planting stock for afforestation schemes were obliged to turn to commercial nurserymen outside Wales.

In 1722, the Chirk Castle estate bought '10 duzon of Scotch Fyr plants' at 1s. 6d. per dozen, and '2 ounces of ye seed' at 1s. 6d. per ounce from Mr. Robert Beck, presumably a commercial nurseryman at Chester.⁴⁵³ Welsh planters often acquired planting stock from far distant nurseries, such as the famous Scottish firm of Dickson's at Hassendeanburn in

Teviotdale (established 1729). Table 22 summarizes a selection of the commercial nurserymen in England, Ireland and Scotland that were patronised by Welsh planters.

Table 22. Some commercial nurseries outside Wales patronised by Welsh planters

Year	Name and location of nursery	Planting site in Wales	Species (seeds or plants)	Source
1735	Walker, Marybone Ireland	Brynddu, Angl.	elms	454
1778	Holbert, Gloucester	-, Brecons.	spruce, silver fir, larch	455
1781	Malcolm, Kennington	Golden Grove, Carms.	many conifers and hardwoods	456
1794	Watts, Piccadilly, London	Pencerrig, Rad.	conifers, chest- nut, oak	457
1795	-, Birmingham	Corsygedol, Merion.	unspecified	458
1796	Mackie, Norwich	Ffynone, Pembs.	larch, beech, elm, Scots pine	459
1790-1800	-, Liverpool	Hafod, Cards.	larch	460
1790-1800	-, Scotland	Hafod, Cards.	larch	461
1800	Miller & Sweet, London	Golden Grove, Carms.	unspecified	456
1817-8	Rogers, Chester	Llanferres, Denbs.	larch, Scots pine	462
1817-8	Dickson, nr. Hawick	Llanferres, Denbs.	larch, Scots pine	462
1822-3	Austin & M'Aslan, Glasgow	Penrhyn, Caerns.	unspecified	463
1835	Dixon, Chester	Stanage, Rad.	larch	464

Table 22 is not an exhaustive list, but it does indicate the surprisingly wide range of nursery sources used. The shortest journeys were Gloucester to Brecon, and Chester to Denbigh. Plants were also freighted by sea from Norwich to Pembrokeshire, wrapped

in matting, and from Ireland to Anglesey. Very long journeys were also made, by road or by a combination of coastal vessel and road transport, from London and Scotland to north and west Wales. These journeys caused deterioration and failure of the planting stock, as described e.g. by Hassall:

Some seedlings are purchased in boxes, from the London and other nurseries; but the high price of the land and labour in those parts, occasions the plants to be so crowded in the nurseries, that when they come to be set out in more exposed situations, they do not often thrive to the satisfaction of the planter⁴⁶⁵

Walter Davies also described the problems associated with buying stock from distant nurseries:

Proprietors planting upon a large scale, and not raising trees from seed in their own nurseries, were formerly used to procure seedlings of larch, firs, and pines, &c from Scotland; but owing to their heating in close bundles, and otherwise damaging upon the road, not above one half, and frequently not above one fourth, of the number, could be expected to grow⁴⁶⁶

This excessive mortality experienced with plants from commercial nurseries led many landowners in Wales either to set up their own estate nurseries or to encourage the development of local commercial nurseries in Wales.

Technical information on nursery management and plantation establishment was contained in the numerous treatises, pamphlets and books on forestry and forest trees that had been published by Englishmen and Scotsmen during the 17th century, and which were available in Wales. It was not until much later, in the mid 18th century, that publications on forest trees by Welsh authors

appeared.⁴⁶⁷ The first of these was ' A Treatise on Forest-Trees, by William Watkins, curate of Hay (Breconshire), published in 1753. Watkins urged landowners to promote planting as a 'public and private Oeconomy', to ensure naval defence, the creation of a strategic reserve of timber, and as a benefit to posterity; he gave practical advice and rules on fencing, site cultivation, the nursery, the management of young plantations, etc.; and also presented directions for the propagation of eleven major tree species or species-groups. These were mainly the major native hardwoods (oak, ash, elm, beech), and also wild cherry, chestnut, sycamore, walnut and lime, but Watkins also dealt with some coniferous species (spruce, Scots pine, cedar and cypress). The other publication emanating from Wales and dealing with forest trees was Idea Agriculturae, written by the Rev. Henry Rowlands of Llanidan (Anglesey) in 1704 but not published until 1764. It dealt inter alia with nursery establishment and management, planting for shelter from sea winds, and the site requirements of various species.

There seem to have been two main types of nursery on estates in Wales, viz. (1) normal seedling nurseries from which plants were removed to their final planting site; and (2) 'nursery woods' or 'nursery plantations', i.e. an area of land marked out, direct-sown, and then gradually thinned out to the desired final density by removing surplus plants to a nursery where they could be held as further planting stock until required; in other words, the equivalent of the transplants or standards section of modern nurseries.

Typical instructions for the formation of seedling

nurseries are those given by Rowlands of Llanidan (Anglesey):

To that End therefore, let every Freeholder or tenant, if he will not go to the Expence of buying Quicksets, fence to himself a little Garden or Nursery in some waste Corner of a Field, of the best and deepest Soil, near his House; and so fence his Nursery that no Cattle may be able to break in upon it, to tear and brouse it; which Garden one may make up in any Place that is convenient for it, with the Labour of two Men in two Days; then let him dig, manure and order the Soil of it, one Day more; and then sow in it the Seeds, Berries, and Kernels of such Quicks and Plants as he will judge will best grow and prosper in the Place; and these Seeds he may in the Seasons of them procure for the Gathering.

This Nursery well dressed, weeded and husbanded, will in a few Years furnish him with Quicks for as many Hedges as he shall have Occasion to raise; and, as he spends his Seminary upon new Hedges, he may resupply it with Seeds, Berries, and Kernels again; and so continue his whole Farm or Tenement with new Fences yearly, till it be thoroughly inclosed, warm, and well sheltered⁴⁶⁸

The other type of nursery, i.e. the transplant nursery, is described by Watkins of Hay-on-Wye (Breconshire). He generally advocated the establishment of plantations by direct sowing on well prepared and securely fenced sites, and then thinning out the surplus trees and removing them to the nursery and planting them at 3 ft. square spacing. The choice and management of the actual nursery site are described as follows:

Your Nursery, in which you intend to train your young Plants for removing, ought to be very well digged, and free from all Weeds; and such a Soil and Situation as is most like to that you design your Trees should be transplanted to for good. For, if your Trees are taken from a good Soil to a steril one, from a deep to a shallow, from a stiff to a light, &c. they will seldom thrive⁴⁶⁹

Watkins recommended growing rarer and more tender plants, e.g. cedar of Lebanon, in boxes for 2 years, and then transplanting into the nursery. A standard 3 x 3 ft. spacing for transplants in the nursery was recommended for oak, ash, beech, wild black cherry, walnut, cedar, pine, and spruce. A wider spacing of 3 x 6 ft. was recommended for 1-year layered lime and elms.

These instructions of course follow the same general pattern as those given in greater detail in the host of treatises on forest trees and their propagation published in England, and there is no doubt but that these standard instructions on nurseries were followed by landowners in Wales. One example will suffice as typical, namely that of John Morris of Clasemont near Morriston (Glamorgan). In the last quarter of the 18th century he planted over half a million trees, principally beech, oak and ash, but also fir, larch, sycamore, birch, sweet chestnut, plane and poplar. A contemporary observer noted that Morris raised nearly all his trees from seed:

when they are about three feet high, he plants them out about a yard distant; when the trees increase in size, ~~so as~~ nearly to touch each other, they are taken out to make further plantations; so that every young wood is in fact a nursery⁴⁷⁰

The seed for the establishment of private estate nurseries was obtained in various ways. Seed of exotics, especially larch and other conifers, had to be bought from commercial nurserymen, (e.g. some of the firms listed

in Table 22). Seed of native species, especially oak, ash and, in south-east Wales, beech, was obtained from local sources. The need to use good parent trees was well known. For example, Watkins' instruction was to gather 'a sufficient Quantity of Acorns off tall straight thriving Trees',⁴⁷¹ but it is certain that seed was often collected and used without any regard to the quality of the parent trees, being bought by the bushel from local people who doubtless gathered from the most convenient source. For example, plantations were made at Chirk in 1718 from acorns gathered locally by children at 15d. per measure⁴⁷², and plantations in Caernarvonshire were made in 1808 using acorns bought for 2s. per bushel⁴⁷³. In the Hafod estate nursery (Cardiganshire), acorns were sown in rows about 1 ft. apart for ease of weeding. The tap roots were pruned with a spade to promote a well ramified root system, and the plants were lifted as 2 + 0 seedlings⁴⁷⁴. 922,000 oak seedlings were produced in the Hafod nursery between 1798 and 1802. Wildings of pioneer species such as birch and mountain ash were also used in some afforestation schemes, e.g. at Hafod⁴⁷⁵.

The following table (Table 23) lists some examples of Welsh estates, large and small, that set up their own nurseries to avoid relying on commercial sources of planting stock, or at least to supplement the supplies obtained from commercial nurserymen. The table is of course by no means exhaustive. It merely gives some examples of what was becoming a common feature of Welsh estates towards the end of the 18th and the beginning of the 19th centuries, namely

the establishment of a regular estate nursery for the production of planting stock of forest trees, often under the supervision of expatriate Scottish staff, employed as gardeners, agents or foresters proper.

Table 23. Some estates in Wales operating their own forest nurseries in the 18th century

Owner	Estate	Date	Type of plants	Source
Sir John Glynne	Hawarden, Flint	1734-47	? oak	476
Sir H. Mackworth	Gnoll, Glam.	1741-68	? pine	477
J.B. Lloyd	Breconshire	1778	spruce, larch	455
Bell Lloyd	Bodvach, Mont.	1780-1800	conifers, beech, oak	478
T. Johnes	Hafod, Cards.	1790-1800	larch, oak, ash, etc.	475
J. Morris	Clasemont, Glam.	1770-96	beech, oak, ash, etc.	470
John Maurice Jones	Denbs. & Merioneth. (nurseries at Dolfriog, Bwlch y Parc, etc.)	1804-1808	many conifers and hardwoods	479
Rev. H.W. Jones	Caerns.	1814	ash, oak	473
Marquis of Bute	Pontneddfechan, Glam.	1800-35	larch etc.	480

Increasing demand for planting stock, coupled with the active promotion of nursery activity by agricultural societies, eventually led to the formation of many small and a few larger forest nurseries in Wales towards the end of the 18th and during the 19th century. The role of agricultural societies was quite significant in some areas, and during the half-century following the establishment of the London Society of Arts in 1754, societies for the encouragement and improvement of agriculture were set up in every county of Wales. The first was the Brecknockshire Agricultural Society (1755), and this was followed by societies in Glamorgan and

Carmarthen (both 1772), Cardigan and Pembroke (both 1784), and Monmouth (before 1794). The Radnorshire Society (later the Radnorshire Agricultural Society) was formed in 1790, the Wrexham (Denbighshire) society in 1796, Merioneth in 1801, Caernarvonshire in 1807, Anglesey in 1808, Vale of Clwyd in 1810, and Flintshire before 1833. Attempts were made to establish a Montgomeryshire agricultural society in 1795 and in 1821.

The societies generally modelled themselves on the London Society of Arts. Some of the societies were short-lived and ineffectual, while others had a long and distinguished history of activity. Their general aim was to improve agriculture by the award of premiums (prizes) to landowners, tenants and others for various classes of crops, livestock, advanced techniques, meritorious behaviour, and so on. Most of the societies gave prizes for the production and planting of hawthorn (white thorn quicks), holly and crabapples for hedge planting, but only a few of the societies, notably those in Brecon, Cardigan and Carmarthen, included the promotion of forestry proper in their sphere of interest in the eighteenth century. The surviving records of these societies are generally very fragmentary, but they show the typical rules and premiums of the societies relating to forestry activities, and also give details of some of the achievements that were rewarded with premiums. For example, the premiums of the Society for the Encouragement of Agriculture and Industry in the County of Cardigan in the 1790s included the following:-

Class IV. Premium I. Planting Forest Trees.

To the person who shall plant, during the season (viz. from September last to May) the greatest number of forest trees, in order to raise timber, not fewer than 4000, and effectually fence and secure them, three guineas.

The next greatest number, not fewer than 3000, two guineas.

Premium II. Planting by a Tenant

To the occupier, being a tenant who shall plant as in the last premium, the greatest number of forest trees, not fewer than 600, and effectually fence and secure them, three guineas. The next greatest number as before, not fewer than 500, two guineas.

Premium III. Planting Willows, &c for Hurdles

To the person who shall plant, during the season, the greatest number of any kind of willows, in the same manner as for a twig garden, (only the plants not quite so close,) or hazel, or any other wood used for twig hurdles and watling, not less than one acre, three guineas.

The next ditto, not less than half an acre, two guineas.

Premium IV. Forest Trees for Sale

To the person who shall have for sale, at the time of giving in his claim, the greatest number of transplanted forest trees of his own raising, in rows about one foot by six inches, from plant to plant, three guineas.

The next greatest number, two guineas.

Premium V. White Thorn for Sale

To the person who shall have for sale, at the time of giving in his claim, the greatest quantity of white thorn plants, on an average eighteen inches high, fenced in, and kept clean of weeds, not fewer than ten thousand, two guineas.

The next greatest number, not fewer than eight thousand, one guinea.⁴⁸¹

The premiums of the Society for the Encouragement of Agriculture and Industry in the County of Carmarthen followed closely the premiums given above for Cardigan.⁴⁸² The

Brecknockshire Agricultural Society gave premiums from 1768 until 1810 for collecting seeds and establishing forest trees. In 1810 the premium was:

XX. To the person (whatever his Property) who shall prepare the greatest Quantity of Land, and sow it with Acorns, Ashkeys, Chestnut, Beechmast, and Seeds of other Timber Trees, and shall preserve the young Growth by Weeding, Hoeing and good Fence against Cattle; keep such Coppices in good Order for five years, not less than two Acres - A Gold Medal five Pounds Value.⁴⁸³

The premiums appear to have been popular, and certainly stimulated planting by tenant farmers. Some of the premiums awarded in Cardiganshire are given in Table 24.

Table 24. Some planting achievements and prizes in Cardiganshire, 1796-8.⁴⁸⁴

Year	Name	Place	No. of trees planted	Prize worth
1796	John Bowen	Cwmbychan Farm, Troed-yr-aur	16,000	3 guineas
1796	John Williams (tenant)	Penywern Fawr, Llandygwydd	1,100	3 guineas
1796	Thomas Williams (tenant)	Blaenllyn, Cardigan	600	2 guineas
1797	Thomas Johnes	Hafod	300,000	1st hon. premium
1797	Sir Thomas Bonsall	Fronfraith	13,000	2nd hon. premium
1797	David Evan (tenant)	Eskerddedwydd, Llandysul	not stated	3 guineas
1798	Col. Lloyd	Bronwydd	60,000	1st. hon. premium

In addition to planters of forest trees, prizes were also awarded to people for establishing osiers and for raising

nursery stock. For example, Daniel Davies of Pant-yr-odyn (Troed-yr-aur parish) was awarded 3 guineas in 1797 for having planted upwards of one acre of willows and hazel for hurdles, wadding and hoops.

The following are typical examples of the awards made for raising forest plants for sale:

1797	Morgan Morgan, Lledrod parish	no. not given
1798	John Williams, Penwernfawr, Llandugwydd parish	20,000 trees
1798	Benjamin Williams, Penwernfawr, Llandugwydd parish	40,000 white thorn
1803	Thomas Williams, Cardigan Mill	15,000 trees
1803	William Richards, Penwernfawr (2nd prize)	8,000 trees

The rules of the societies prevented any individual landlord from taking the prize year after year, and landowners generally received only honorary prizes. Their aim was to inspire the tenants and peasantry by their example, and the prizes in the form of cash, cups or implements were generally reserved for the small men. Though the emphasis in Breconshire was on the production and planting of native hardwoods, the premiums in Cardigan often went to men such as Thomas Johnes, the bulk of whose commercial planting consisted of European larch. The agricultural societies promoted tree planting, nurseries and forestry in general in only three counties (Brecon, Cardigan, Carmarthen), and even here the effect was significant only for about a period of 40-50 years (from roughly 1770 to 1810). It appears that interest in forest planting generally declined thereafter.

Besides the active promotion of nurseries by the agricultural societies, one of the main factors promoting the development of local forest nurseries in Wales was undoubtedly the expense and delay involved in purchasing planting stock from nurserymen in England and Scotland, and also the dubious quality of many of the plants, as a result of the long transport times. The planter's fear of a high failure rate was presumably one reason why some nurserymen undertook to establish plantations and then to 'insure' them for several years, with regular inspection and making good any failures by beating up. A good example of this system is a large waste-land afforestation scheme at Llanferres (Denbighshire), for which the owner, Henry Potts, was awarded the large Silver Medal of the Royal Society of Arts in 1821. Some 194 acres were planted up with 528,240 forest trees, chiefly European larch and Scots pine, the planting being done by Messrs Archibald Dickson & Sons, nurserymen of Hassendeanburn near Hawick, between October 1817 and April 1818. Several hardwood species were also included in the planting. The numbers and types of trees, all from the Scottish nursery, were vouched for in a certificate supplied by Archibald Dickson, who also inspected the plantations in November 1820.⁴⁸⁵

The many small and a few larger commercial nurseries in Wales produced a quite wide variety of forest planting stock and hedging plants. Unfortunately many of these nursery enterprises were short-lived, or ran on a cottage-scale only,

and records and documentary evidence are at best fragmentary, even for the larger nurseries. The following table (Table 25) indicates something of the geographical range and date of operation of commercial nursery enterprises in Wales, but in most cases little or nothing is known of the nurseries themselves beyond the mere fact of their existence.

Table 25. Some commercial nurserymen in Wales in the 18th and early 19th century.

Date	Name of Nurserymen	Location of nursery	Source
1785	Thomas Hughes	Llansantffraid, Denb.	486
1795	Thomas Vickers	Holywell, Flint	
1793	Walter Scott	Carmarthen	
1793	John Drew	Cardiff	
1793	Francis Minnit	Cardiff	
1793	Thomas Roberts	Cardiff	
1793	Robert Arnot	Cowbridge, Glam.	
1795	William Evans	Llandaff, Glam.	
1795	John Franklin	Llandaff, Glam.	487
ca.1800-1810	John Williams	Burgedin, Welshpool	
ca.1800-1815	James Evans	Velindre, Carms.	
ca.1800-1815	Hindes	Velindre, Carms.	"
1828	Planhigfa Henfelin	Treiorwerth, Angl.	489
1832	Planhigfa Llynfaes	Llynfaes, Angl.	"

Pigot & Co's National Commercial Directory (1830) notes gardeners and seedsmen in Brecon (2), Carmarthen (2), Haverfordwest (2), Knighton (1), Swansea (3), and Tenby (1). In 1848 the Swansea nursery of White & Melville advertised themselves as 'Nurserymen, Seedsmen, & Florists, Landscape Gardeners, & Planting Contractors able to furnish Forest and Fruit Trees, Evergreen and Flowering Shrubs, American Plants ...' ⁴⁹⁰

Some of the nurserymen listed in Table 25 are known to have published printed catalogues, but unfortunately none of these appear⁴⁹¹ to have survived. Some details of size of the nurseries and the types of plants produced at Burgedin and Velindre can be obtained from reports to the Board of Agriculture. At Burgedin, Mr. John Williams managed a 'very extensive concern in the nursery line', and inserted as an appendix to his printed catalogue of forest trees the following advertisement: 'One and two-year-old seedlings of all sorts of forest trees, nearly as cheap as in Scotland, reckoning carriage, and one thousand worth two of theirs'. Walter Davies considered that this was true when the tenderness of seedlings, distance of carriage, and length of time, are considered.⁴⁹² Williams and other Welsh nurserymen followed the example of the big Scottish nursery firms, and guaranteed trees of their own growth and planting for a number of years.

There were no commercial nurseries of any size raising forest trees for sale in Carmarthenshire in 1794, as evidenced by Hassall's statement: 'I do not find that there are any nurseries for raising forest trees for sale, in sufficient quantities to supply a great demand'.⁴⁹³ However, the situation in Cardiganshire and Carmarthenshire improved considerably in the next 20 years, and by about 1815 there were in the area six nurserymen, some occupying nurseries from 5 to 10 acres in size.⁴⁹⁴ The largest of these was Mr. Hindes' nursery at Felindre (near Newcastle Emlyn, Carms.), which occupied some 18 acres on a site rather unwisely chosen with poor clay soil

and some peat, which needed expensive draining. In 1810-15 Hindes' sales of forest trees from this nursery averaged about 400,000 plants a year. One year he sold a total of 578,596 plants, consisting of 576,365 forest trees, 1506 fruit trees, and 725 flowering shrubs. The prices of plants ranged from 20s. to 50s. per 1000, according to size, species and demand. Hindes' nursery stocked seedlings, transplants and standards of over 20 species of forest trees, as the following inventory shows:-

<u>Species, age and size of plants</u>	<u>No. of plants</u>
Oak seedlings [1 + 0 stock]	500,000
Oak seedlings, 2 and 3 years, transplanted [1 + 1, 1 + 2]	90,000
Ash seedlings, 2 years old	200,000
Ash seedlings, transplanted, 1½-4 ft.	160,000
Beech, transplanted, 1-4 ft.	50,000
Birch, various ages	10,000
Horse chestnuts, transplanted	5,000
Spanish chestnuts, transplanted, 2-4 ft.	3,000
Wych elm, transplanted, 2-4 ft.	13,000
English elm, transplanted, 4-7 ft.	5,000
Sycamore	20,000
Mountain ash	20,000
Plane trees, 6-9 ft.	200
Lime trees, 4-5 ft.	500
Black poplars	3,000
Silver & Balm of Gilead fir [Abies alba & A. balsamea]	5,000
Spruce firs, various sorts and sizes [Picea abies]	50,000
Scotch pines, 1-3 years transplanted	500,000
Weymouth pines and pineasters [Pinus pinaster]	3,000
Larch seedlings [Larix decidua, 1 + 0]	300,000
Larch seedlings, 2 years transplanted	200,000
	<u>2,137,700</u>
White thorns and crab stocks for grafting, 1-4 years	500,000
Apple trees, of choice sorts	3,000
Total	<u>2,640,700</u>

Like the big Scottish nurserymen, Hindes undertook planting on contract. For example, on one estate in the Teifi Valley he planted a total of 395,000 trees over a period of three successive spring planting seasons (1811, 1812, 1813). The plants were 2- and 3-year-old larch, firs, pines, oak, ash, elm and beech. The plantation was established at the following charges:

Planting stock, per 1000	£1 0s.
Carriage (15 miles), per 1000	4s.
Planting, per 1000	<u>12s.</u>
	<u>£1.16s.</u>

Hindes guaranteed the growth of 17 plants out of every 20, i.e. he undertook to make good any early mortality by beating up to the specified survival rate. The whole plantation cost £711.

Even in Anglesey, notoriously the most treeless of the Welsh counties, commercial nurseries were established in the first half of the 19th century.⁴⁹⁵ For example, one nursery was established at Maesyllan, another at Henfelin was offering half a million trees for sale in 1828, and another at Llynfaes sold over 100,000 plants in 1832, and had a stock of half a million plants growing.

Side by side with the larger nurseries there developed in Wales a 'cottage-scale' forest nursery industry. Its beginnings were indeed humble:

Cottagers, who at first tried by way of experiment, to raise a few plants from the cones of firs, and pines, from acorns, or other mast, to shelter their own dwellings, have by degrees been encouraged to extend their nurseries, and accommodate the public with plants ⁴⁹⁶

Iolo Morganwg gives an early example of forest tree planting by a Welsh cottager: the bard Benjamin Simon (1703-93), a shoemaker or bookbinder who died a pauper, planted a wide range of conifers and hardwoods for shelter around his cottage at Porth Myrddin near Abergwili (Carmarthenshire) ca. 1740-50. ⁴⁹⁷

The very small nurseries, producing forest planting stock and also whitethorn and blackthorn quicksets for hedging, were a feature of the countryside in Wales in the 19th century. They were called gerddi coed bach (small tree gardens), and were usually tended by local women, some of whom had obtained experience in London nurseries as migrant workers. ⁴⁹⁸ A delightful description of the women and the nurseries near Tŷ Mowr village (Llanybydder, north Carmarthenshire) has been recorded:

Tyfid y planhigion, i gychwyn, o hadau ... 'Roedd yn bleser eu gweld, ac ambell hen wraig mewn pais a betgwn â'i rhaw fach yn agor rhychiau, neu'n dyfal chwynnu ar ei chwrcwd. Rhedai'r rhesi'n syth fel edau lin, a'r miloedd picellau gwyrddion, main, yn gwanu'r awyr fel byddin o dir y dyneddon' [The plants were grown from seed ... It was a pleasure to see them, with a few old women in Welsh dress and petticoat opening the drills with small spades, or squatting down weeding industriously. The rows ran as straight as linen threads, and thousands of fine green spears pierced the air like an army from Lilliput] ⁴⁹⁹

Some of the orders placed with English nurseries are revealing in that they show the surprising variety of trees being planted on Welsh estates before 1800. For example, in 1794 Thomas Jones of Pencerrig in Radnorshire bought from a London nursery:

100 Balm of Gilead, bedded
 50 White American Spruce, bedded
 50 Black American Spruce, bedded
 200 Spanish Chestnut, 3-year-old
 100 Filberts, 3-year-old
 100 Stone or Italian Pine, 2-year-old
 100 Pine ashes, 2-year-old
 100 Cluster Pine, 2-year-old
 1 Quart Ilex Acorns ⁵⁰⁰

and John Vaughan of Golden Grove, Carms., bought the following from a Kennington nursery in 1781:

600 Weymouth Pines
 600 Spruce Firs
 200 Silver Firs
 500 Common Larch
 600 Portugal Laurels
 300 Common Alaternus
 24 Hemlock Spruce Firs
 400 lime trees
 24 Alexandria Laurels
 200 New White Broom
 400 Common Laurels
 150 Fine Red Virginian Cedars
 24 Cedars of Lebanon
 as well as Scotch Fir,
 Spanish Chestnut, Beech, etc. ⁵⁰⁰

The prices of forest seed and nursery plants varied with the species, age, height, nursery source, size of order, demand, and transport costs. Only rarely do records give adequate details of the type and cost of planting stock used, and therefore it is not easy to reconstruct any pattern in prices, more

especially as no early catalogues of Welsh nurserymen have survived. Table 26 summarizes some information on prices.

Table 26. Some prices of forest tree seed and planting stock bought by Welsh planters

Date	Planting site	Type of material	Price	Source
1664	Chirk	Cypress trees	1s. each	502
1718	Chirk	fir and other seed	$\frac{1}{2}$ guinea for 6 oz.	
1718	Chirk	acorns	15d. per measure	
1722	Chirk	Scots pine plants Scots pine seed	18d. per dozen 18d. per oz.	
1778	Brecon	spruce fir plants	2 guineas per 100	455
1778	Brecon	spruce, larch & silver fir seed	1s. per oz.	
1781	Golden Grove, Carms.	spruce, larch, lime plants	25s. per 100	501
1781	Golden Grove, Carms.	silver fir, red Virginian cedar plants	£2.10s. per 100	
1796	Ffynone, Pembs.	larch 2+0	10/- per 1000	459
1796	Ffynone, Pembs.	beech and Scots pine, 2+0	5/- per 1000	
1796	Ffynone, Pembs.	English elms, 2+0	8/- per 1000	
1804	Stanage, Rad.	Lucombe Oaks	1/9 each	464
1804	Stanage, Rad.	Weymouth pine	21/- per 100	
1804	Stanage, Rad.	planes	25/- per 100	
1811-13	Carms.	larch, fir, pine, oak, ash, elm, beech, 2 and 3 years old	£1 per 1000	494
1814	Caerns.	trees 3 ft. high (average catalogue prices)	8s. per 100	473
1814	Caerns.	acorns	2s. per bushel	
1815	Velindre, Carms.	various hardwoods and conifers	20-50/- per 1000	494
1827	Stanage, Rad.	seedlings (larch, Scots pine, spruce, beech, oak etc.)	30/- per 1000	503
1832	Anglesey	plants (quicksets?)	5/- per 1000	489

These prices conform broadly with those given by Harvey from his analysis of some 30 priced catalogues of English and a few Scottish nurseries, covering the period 1775-1845.⁵⁰⁴ The general picture Harvey gives is of stability of prices before 1800 and gross variations thereafter, starting at a high level and generally dropping.

The following table (Table 27) lists the species known to have been planted on estates in Wales in the period 1750-1825. The list contains all the major species that were planted commercially and many that were planted as ornamentals, though it is probable that some other species not included in the list were planted as ornamentals.

The main commercial species used in plantations during the 18th and in the first half of the 19th century were the European conifers (Scots pine, Norway spruce and European larch, and small amounts of silver fir), and the native or long-naturalized hardwoods, viz. principally oak, ash, beech, elm and sycamore. Throughout the 18th century, many plantations, of conifers and of hardwoods, were established by direct sowing of seed in patches of prepared soil at a spacing of about 8 x 8 ft., and thinned out later as necessary. Increasingly during this century plantations were also established with seedlings or with transplanted stock (often quite large plants). Elm and lime were usually established by planting layered plants, and poplars by cuttings.⁵⁰⁵

Table 27. Species known to have been planted on Welsh estates, 1750-1825.

Conifers		Broadleaves	
Larch	Larix decidua	Oak	Quercus robur, Q. petraea
Scots pine	Pinus sylvestris	Beech	Fagus sylvatica
Norway spruce	Picea abies	Birch	Betula spp.
Silver fir	Abies alba	Ash	Fraxinus excelsior
Pineaster or cluster pine	Pinus pinaster	Mountain ash	Sorbus aucuparia
Balm of Gilead fir	Abies balsamea	Lucombe oak	Quercus x hispanica 'lucombeana'
Weymouth pine	Pinus strobus	Portuguese laurel	Prunus lusitanica
Corsican pine	Pinus nigra var. maritima	Scotch elm	Ulmus glabra
American larch	Larix laricina	English elm	Ulmus procera
White American spruce	Picea glauca	Spanish chestnut	Castanea sativa
Black American spruce	Picea mariana	Horse chestnut	Aesculus hippocastanum
Italian pine	Pinus pinea	Sycamore	Acer pseudoplatanus
Newfoundland pine	Pinus (?)	Alder	Alnus spp.
Hemlock spruce fir	Tsuga canadensis	Willow	Salix spp.
Red Virginian Cedar	Juniperus virginiana	Poplar	Populus spp.
Cedar of Lebanon	Cedrus libani	Black Italian poplar	Populus x euramericana
Italian Cypress	Cupressus sempervirens	White Italian poplar (abele)	Populus alba
Yew	Taxus baccata	Athenian poplar	Populus sp.
		Golden willow	Salix sp.
		Balsam poplar	Populus balsamifera
		Filberts	Corylus avellana
		Ilex oak	Quercus ilex
		Limes	Tilia spp.
		Walnut	Juglans regia

Acorns were either dibbled in, or sown in small prepared patches. For example, at Hafod the technique was to pare off a thin turf with a spade and throw it over. The exposed soil was loosened with the spade, and a spadeful lifted up, 2-3 acorns were thrown in by a boy and the earth replaced and gently trodden down.⁵⁰⁶ These direct sowings of oak often gave excellent survival and growth rates, especially in the eastern parts of Wales. For example, Sir Humphrey Howarth (MP for Radnorshire from 1722 until his death in 1754) had set acorns himself and most of them had grown to timber of 20 inches square within his lifetime.⁵⁰⁷

Though native in south-east Wales (cf. p.234), beech had not spread naturally northwards and had been planted little if at all in north Wales by 1700, as evidenced by Edward Lhuyd in two letters:

'in noe part of Northwales is found any flint or chalk, nor beech trees (1 July 1690);
'In South Wales I found several plants common, which I had never seen in North Wales, such as ... Fagus (24 Nov. 1696).⁵⁰⁸

A century later, another competent reporter, Iolo Morganwg, reported a few instances of beech as 'curiosities' in north Wales, e.g. at Rhiwlas (Merioneth), Foelas and Cinmel Park (Denbighshire), and Gwydyr and Conway (Caernarvonshire):

'Beech grows spontaneously in great abundance on Carreg y Gwalch (Gwydyr);
'very fine grove of many thousands of beech planted within the memory of living. some girt $6\frac{1}{2}$ feet, many upwards of five. they are strait & very tall. a proof that beech will succeed in N.W. and once introduced will, as at Gwydir, propagate themselves. they grow here [near Conway] on a bare schist.⁵⁰⁹

Over 150,000 beech trees were planted on the Denbighshire and Merioneth estates of Mr. John Maurice Jones in the six planting seasons from 1804/5 to 1809/10.⁵¹⁰

Sycamore was extensively planted for shelter, and as a producer of valuable wood particularly suitable for the manufacture of dairy utensils. Sycamore was planted early in the 18th century e.g. on the Chirk and Margam estates, and later in quite considerable numbers on many other estates throughout Wales, e.g. over 50,000 sycamore trees were planted on the Mr. John Maurice Jones' estates in 1804-1810.⁵¹⁰

The interest in fast-growing plantation species extended also to poplars, which were planted widely on many estates. For example, in the period 1804/5 to 1809/10, a total of well over 75,000 poplars were planted on the estates of Mr. John Maurice Jones in north Wales, viz.:

- over 60,000 black Italian poplars
- " 9,800 white Italian poplars
- " 6,000 unspecified poplars
- " 600 balsam poplars
- " 300 Athenian poplars.⁵¹⁰

The questions of spacing and pruning with poplars were matters of interest and debate. The stem dimensions of the trees in a small block of black poplar, planted in 1774 at a square spacing of ca. 9-12 ft. on alluvium or mixed gravel and loam at Tre-ffin (Montgomeryshire), were measured in 1805 and analysed.⁵¹¹ Stem volume growth was by far the greatest in unpruned trees having the greatest growing space.

An essential requirement for successful plantation establishment in Wales was adequate protection from trampling, barking and browsing by cattle, sheep and goats. This involved building walls, hedges, fences, or banks surmounted by a wall, hedge or fence. All records of planting and recommendations on plantation establishment emphasise the vital importance of protection from livestock, especially sheep. At Hafod, for example:

'The plantation grounds were all properly inclosed before any of the trees were planted. The greatest part of the plantations is fenced with a stone wall, five feet high; the remainder with a turf-fence, the same height, with a dead hedge, and willows planted on the top ... The stone walls which surround the plantations are all kept in proper repair by a man who has a yearly allowance for that purpose ^{5/2}

Even with all these expensive precautions, sheep still caused severe damage to some of the Hafod plantations. The plantations of John Maurice Jones in the counties of Denbigh and Merioneth in 1804-9 were protected by walls 6 ft. high, or by quickset hedges, ^{5/3} and at Stanage (Radnorshire) a mixed plantation made in 1807/8 was enclosed by a 'park paling' on one side and fleakes or cleft hurdles on the other. ^{5/4} In some areas of north Wales, sheep were even hobbled in an effort to protect enclosed plantations. ^{5/5} Goats, though not as numerous as sheep, also presented great problems in north Wales. In Merioneth landlords generally prohibited their tenants from keeping goats, which were very destructive

not only to young plantations but also to older trees:

where the trees are so high that they cannot easily get at the branches, they stand erect and pull them down, with their fore legs, holding them in that manner until they totally destroy the tree.⁵¹⁶

Draining was an expense that was avoided wherever possible in afforestation schemes, but considerable drainage works were undertaken on some estates, e.g. Corsygedol (Merioneth) in the big plantings carried out there during the period 1795-1815.⁵¹⁷

Site preparation within the enclosures depended on the method of plantation establishment, and on the ground cover. For direct sowing, the general rule was complete ploughing or digging, or the cultivation of prepared patches. Smaller seedlings or transplants were notch-planted, usually with no or only minimal soil cultivation. Larger plants were hole-planted.

The sites afforested were generally those judged incapable of improvement for agriculture, i.e. usually sites that were too steep and uneven, or with very shallow and stony soils. In the period of planting at the end of the 18th and early in the 19th century, the areas planted were generally up to 1000 ft. or in some cases even up to 1200 ft. above sea level.

The size of planting stock varied according to the species and the preference of the planter (cf. pp. 209-213),

but for conifer plantations, 2+0 seedlings were generally preferred. For example, at Hafod, Thomas Johnes said:

I look upon the two-years-old seedling Larches as preferable to any other sizes for planting high grounds, as the winds make little or no impression upon their tops before their roots get properly fixed in the grounds ⁵¹⁸

Similar stock was used for a 90-acre plantation in the parish of Beddgelert in 1814, viz. 2+0 oak, Scots pine and larch. ⁵¹⁹ Again in a planting of 528,240 trees in 1817/1818 at Llanferres (Denbighshire) the bulk of the planting stock were 2+0 seedlings of Scots pine and larch, and some larch transplants 9-18 inches tall. ⁵²⁰

The method of planting also depended on the stock. Holes had to be dug for larger plants, but most estates found the labour requirement and expense required for hole-planting to be excessive for large plantation schemes. An example of the practice of hole-planting can be cited from Stanage (Radnorshire) where in 1808/9 a total of 5000 larch 3-7 ft. high and 4000 oak 2-4 ft. high, were planted in holes ca. 15 inches in diameter, at a spacing of 3-4 feet. The holes were dug and prepared by men, but the actual planting was done by women and children, the children holding the tree and the women putting in the mould and firming the trees in with their feet. ⁵²¹ The Stanage estate persisted in hole-planting: in 1827, 35 acres of ground were planted with 66,500 trees (Scots pine, spruce, larch, silver fir, beech, oak and sweet chestnut). The total cost of establishing

the plantation was £153 13s. 7d. of which the planting stock accounted for £99 15s., while the making of 48,400 holes cost £23 7s. 10d.⁵²²

For smaller plants, nicking-in or notching with a spade or mattock was the general method of planting. For example, at Hafod the larch was notch-planted as follows:

A man with a spade, holding the edge of it towards him, makes a cut about six inches deep if there is that depth of soil; he then turns the spade the right way and makes a cut across the end of the other thus 1; he then works his spade backwards and forwards three or four times, to loosen the mold for the roots of the plants to grow therein. A boy attends with a bundle of trees, to assist every man: the boy puts one tree in each hole, and presses with his foot the turf hard about the roots, to make the tree stand firm.⁵²³

The technique was similar on other planting schemes, e.g. at Beddgelert:

the labourers being each provided with a small pick or mattock, and a basket to hold the plants, and placing themselves within a yard of each other, proceed to work, striking the broad end of the mattock deep into the ground, and loosening the soil a little the plant is then placed in the hole, and the soil well closed about it with the heel ... The labourers are supplied with plants by boys, who carry them from the persons who dig them up, and shorten their roots.⁵²⁴

Planting rates at Hafod for a man + boy team were 1000 per day. In the Beddgelert planting, a good workman was expected to plant at least 500 plants in a day. Supervision was often strict - e.g. at Hafod one man's job was to give each newly planted tree a tug to see that it was properly

planted and firmed in; the plants were generally put in so hard that the top would break before they could be pulled up.

The planting season was from October through to the spring, sometimes as late as April. Care was taken to protect bare-rooted planting stock from desiccation between the nursery and the planting site. The Scots staff on the Hafod estate devised a method of coating the roots with a slurry made of 'muck water and finely sifted mould', especially for plantings carried out late in the spring. The technique was as follows:

'a hole is dug about two feet in diameter and the same in depth; it is then half-filled with water, and fine mold is added, to make it like thin mud: a man then takes as many trees in both his hands as he can conveniently hold to drench in the mud: having prepared a heap of dry soil near the side of the hole, he alternately draws the roots of the plants through the above mud-hole and the dry soil, and thus the fibres of the roots are prevented from hardening or drying, as they would otherwise do ⁵²⁵

The technique was successful, for in a plantation of 80,000 larch planted on a very dry site in April 1796 and which had little or no rain for nearly 2 months after planting, the total mortality was not more than 200 (0.25%).

Plant spacing varied with the species and size of the planting stock. In the earlier plantings on the Hafod estate, 2+0 seedling larch were planted at 2x2 ft., 1-year

transplants at $2\frac{1}{2} \times 2\frac{1}{2}$ ft., and larger plants at $3\frac{1}{2} \times 3\frac{1}{2}$ ft. With the youngest plants, this gave a planting density of about 10,000 plants/acre; in the later years, larch was planted at 4000 plants/acre. Also at Hafod, ash 1-3 ft. high were planted 6-8 ft. apart and oak 1-2 ft. high at 4-5 ft. apart.⁵²⁶

In the waste-land afforestation scheme at Llanferres, the spacing was mainly 4 ft., but somewhat denser ($3\frac{1}{2}$ ft.) in the more exposed places. In re-planting a cleared woodland site at Llanferres, oak was planted 9 ft. apart, with beech, sycamore and larch planted $4\frac{1}{2}$ ft. apart as nurses to the oak.⁵²⁷

In the plantings in the Denbigh/Merioneth estates of John Maurice Jones in 1804-1809, the planting densities were generally of the order of 5000-9000 plants/acre.⁵²⁸

Much wider spacings were advocated for larch by Iolo Morganwg, from his observations of the plantations at Pen-pont (Breconshire). He proposed either a spacing of $5\frac{1}{2} \times 5\frac{1}{2}$ yards, i.e. 160 plants/acre on a 40-year rotation, which would ensure abundant yields of grazing forage throughout the life of the plantation, or a spacing of $8\frac{1}{4} \times 8\frac{1}{4}$ ft., i.e. 640 plants/acre, which would still produce large amounts of grazing in addition to the wood.⁵²⁹

The pattern of forestry in Wales from the late 18th century onward was greatly influenced by the Scottish staff employed as foresters proper, gamekeepers, agents or bailiffs on the larger private estates. During the 18th century, a generation of skilled practical foresters arose in Scotland,

familiar with their native Scots pine and with large-scale softwood plantation forestry as exemplified by the larch planting of the Dukes of Atholl. The pre-eminence of Scots foresters in experience and reputation is reflected in the way in which they were sought after for positions in Wales and elsewhere - it was both fashionable and practical to employ Scots as foresters on Welsh estates.

Some early examples may be given of Scots whose duties consisted wholly or partly of the supervision of forestry on Welsh estates: a Scot named Robson was in charge of the Gnoll Estate (near Neath, Glamorgan) in 1787;⁵³⁰ on Thomas Johnes' Hafod Estate (N. Cardiganshire) in ca. 1790-1810 the extensive plantations and forest-nursery activity were in the charge of two Scots, the bailiff John Greenshields, and the gardener James Todd, who had been the former head-gardener of the Botanic Garden at Edinburgh;⁵³¹ in 1814, a Scot named George Robson was appointed steward of the Crosswood Estate (Cardiganshire).⁵³² Later on, in the 19th century, more and more Scots foresters were employed on estates throughout Wales. The following list is merely a selection of those traced in the course of this research, and is in no way complete:

Some Scots Foresters on Welsh estates in the 19th century⁵³³

Peter G. Balden	Vaenol Park (Caerns.)
Lewis Bayne	Kinmel Park (Denbs.)
Robert Cameron	Pale (Merioneth)
David Guthrie	Hafodunos (Denbs.)
Angus Macintosh(M'Intosh)	Llanerch (Carms.)
Thomas M'Kay	Crosswood Park (Cards.)
James McNair	Hafodunos (Carms.)
Archibald Mitchell	Dunraven Castle (Glam.)
J. Muir	Margam (Glam.)
A. Pettigrew	Bute (Glam.)
H.A. Pettigrew	St. Fagans (Glam.)
Walter Ritchie	Dinas Mawddwy (Merioneth), and Doldowlod (Radnor)
Robert Russell	Mostyn (Flint)
Alexander Stewart	Bodnant (Denbs.)
D. Scott	Penrhyn Castle (Caerns.)
David Tait	Gwysaney (Flint)
A. Waterson	Penrhyn Castle (Caerns.)
Angus D. Webster	Penrhyn Castle (Caerns.)
Alexander Whitson	Kinmel Park (Denbs.)

In the period from ca. 1780 onwards, planting was undertaken on most estates in Wales, often on a quite large scale, but it is not possible to get accurate statistics. The Rev. Walter Davies, reporting on the state of agriculture in Wales for the Board of Agriculture, estimated that the rate of planting in South Wales in the period 1800-1815 was of the order of at least 3 million trees per annum.⁵³⁴ The figure for North Wales was probably of a similar order. Most of this planting was afforestation of non-woodland sites, and represented an over-all annual planting rate of perhaps 500-1000 acres per annum. Table 28 summarizes some of the major planting operations during the period 1770-1830.

Table 28. Some of the major planting operations in Wales, 1770-1830

Estate & County	Period	No. of trees planted	Area planted (acres)	Source
Clasemont, Glam.	1770-1795	500,000	-	535
Hafod, Cards.	1782-1816	ca. 5 million	1000-1200	536
Chirk, Denbs.	ca. 1770-1790	-	ca. 700	537
Lloyd, Caerns. & Flint	until 1794	ca. 500,000	-	538
Lloyd, Mont.	-	204,000	ca. 70	} 539
Lloyd, Caerns. & Flint	1795-7	125,000	-	
Penrhyn, Caerns.	1780-1797	600,000	-	540
J.M. Jones, Denb. & Merion.	1804-1810	1,712,450	261	541
Llangenech, Carms.	1804	460,000	-	} 542
Peterwell & Millfield, Cards.	1811-1813	395,000	-	
Talbot, Margam, Glam	1780-1814	? 1,000,000	-	
Beddgelert, Caerns.	ca. 1813	ca. 420,000	91	543
Newborough, Denbs. & Caerns.	1815-1827	3,738,000	-	544
Potts, Llanferres, Denbs.	1817/8	528,240	194	545
Stanage, Radnor.	1805-1831	> 651,808	-	546

Some of the major landowners in Wales not only earned premiums for tree planting from their local agricultural societies, but also were awarded gold and silver medals by the London (later the Royal) Society of Arts. Among these, the outstanding figure is Thomas Johnes of Hafod (Cardiganshire) who was awarded gold medals on no fewer than five separate occasions (1800, 1801, 1802, 1805 and 1810).⁵⁴⁷ Other Welsh winners were Charles Rogers of Stanage, Radnorshire (gold medal, 1835), Henry Potts of Llanferres, Denbighshire (large silver medal, 1821), and Lord Newborough (gold medal, 1828) for planting on his estates in Denbighshire and Caernarvonshire.⁵⁴⁸ The Society abandoned the practice of giving awards for tree-planting about the middle of the 19th century, but it continued to promote

good forestry and to press for State action in this field.

By the early 19th century, conifer plantations were becoming a significant feature of the landscape of Wales. Even as early as 1791, replies to a government questionnaire survey on planting indicated that in most counties in Wales the plantations were of tree species not 'fit for the navy' (i.e. oak), and mostly of fir or other soft wood.⁵⁴⁹ On some estates, e.g. Hafod (Cardiganshire) the larch plantations accounted for well over half the total woodland acreage of the estate.⁵⁵⁰ On the Gnoll estate (Neath, Glamorgan) in 1815 the woods and plantations formed some 173 acres (7%) of the total area of the estate (2445 acres), and 'fir' plantations accounted for at least 20% of all the woods and plantations on the estate.⁵⁵¹ Since about 1750, many landowners in Wales had obviously become enthusiastic planters of conifers. The attitudes of the common people to this development are not known, though they presumably derived some benefits from the additional employment generated by the establishment and maintenance of the conifer plantations. Like the English traveller Wyndham (cf. p. 193), Iolo Morganwg realized the value and benefits of fast-growing conifer plantations, especially of larch, which had rapidly become the most popular of the conifers planted. Its early growth rate was superior to pine and spruce. Some of the earliest plantings of larch were at Pen-pont (Breconshire) in ca. 1750. Observations and measurements of these plantations ca. 40 years later, were reported by Iolo Morganwg, and the larch compared favourably with spruce and pine of the same age. Some of the larch were 60 ft. high and girthed 8 ft.⁵⁵² In north Wales (at Rhiwlas, Merioneth) Iolo also noted:

Larch luxuriant. I hope this will soon be the favorite tree of Wales to clothe its mountains ... larch is a much more valuable timber of speedier growth and greater beauty [than fir] ⁵⁵³

Larch was also looked upon with favour because it was believed to be less attractive and palatable to sheep than most of the other tree species planted in Wales.

In general, 'fir' (i.e. Scots pine or Norway spruce) was neither planted as widely nor regarded as favourably as larch. For example, at Rhiwlas (Merioneth) Iolo Morganwg criticized

a tall & large grove of firs in an abominable taste of Cockneyism. Was glad to see them marked for a general fall [i.e. clear felling], their timber consigned to useful purposes, and their dirty verdure to the flames ⁵⁵³

Some English travellers in Wales in the late 18th and early 19th century were of a similar opinion. Fenton wrote of hills 'deformed with miserable clumps of Firs' near Kerry (Ceri, Montgomeryshire), and of views 'disfigured by a strait belt-planted line of grim fir trees' at Gwydyr, though he too was more favourably disposed to larch, e.g. at Drws-y-nant (Merioneth) the larch had the 'most flourishing look ... Wherever they are seen their shoots are amazing and their bark betrays health', and at Gwydyr 'the Larch seems to suit the Soil best, and outshoots every other species of tree'. ⁵⁵⁴ Byng regarded both larch and Scots pine as 'proper ornaments for a desert'. ⁵⁵⁵

These English travellers in Wales were seeking the romantic and the picturesque. Almost without exception,

those who recorded accounts of their journeys complained in exaggerated terms of the universal and widespread felling of the native oak woods. Two examples are typical of many others:

- Bingley: 'It is truly lamentable that the practice of taking away the timber should be so general ... Depriving scenery of wood is ruinous to picturesque beauty; and if the owners of land do but go on in the manner they have done, for a few years longer, there will be scarcely a tree remaining in all North Wales'.⁵⁵⁶
- Byng: 'The sides of these hills abound with woods of oak ... they clear the ground entirely, and then succeeds a crop of oats: destructive, idle - ignorant management! ... they now in Wales make a sweep, and fell every oak! So that the land then becomes a brushy common, open to cattle never to produce timber again'.⁵⁵⁷

The great diversity of species choice and plant spacing discussed above shows that there were few generally accepted principles in plantation forestry. Personal predilections and availability of planting stock dictated the form and composition of the plantations. Though many plantations, especially of larch, were established as pure stands, mixtures were probably more popular. There were various reasons for the formation of mixtures:

- i) in order to eke out scarce and expensive planting stock, especially of conifers, by planting among native hardwoods. This was a favourite method of establishing larch, Norway spruce and Scots pine by planting in amongst oak early in the 19th century, and the method was also practised later on with other exotics, e.g. the earliest plantations of Douglas fir established by planting amongst hardwoods and other conifers in north Wales in the second half of the 19th century (cf. pp. 233-4).

- ii) in order to experiment, i.e. to determine which species gave the best performance on any given site; for example, at Clasemont (Glamorgan) John Morris was reported as planting:

trees of various kinds in each acre of ground, by which he observes the sort that best suits the soil, exposure &c.⁵⁵⁸

- iii) in order to insure against the failure of one species, in the belief that mixtures were healthier than pure stands. This practice became widespread during the 19th century in an effort to counter the 'decline' of European larch (cf. pp. 271-2).
- iv) in order to create a varied landscape for aesthetic reasons, such as that described by John Dyer in his description of Grongar Hill in the Vale of Towy in 1727:

Below me trees unnumbered rise
Beautiful in various dyes:
The gloomy pine, the poplar blue
The yellow beech, the sable yew
The slender fir, that taper grows
The sturdy oak, with broad-spread boughs

As silvicultural awareness increased, the need to provide nurses for oak and to thin plantations was appreciated. The special role of birch as a nurse for oak was recognized in the Welsh saying mamaeth y dderwen yw'r fedwen^{*}, and expressed clearly by a woodman in the Vale of Neath:

^{*}The birch is nurse to the oak

birch, or some other upright growing underwood, should always be planted with oak, and left uncut with it, to train it up clean and straight, as well as to shelter it.⁵⁵⁹

As with species choice and spacing, considerable diversity of opinion also existed concerning thinning and pruning. Contemporary observers of woods and plantations in Wales generally agreed upon the need for thinning, but most reports in the early 19th century indicate that thinning was frequently neglected and that plantations (which were in any case usually established at very high initial planting densities) were left excessively dense and often in a state of stagnation. In a graphic description of one plantation, the trees

were so closely confined, that, like the unfortunate captives of Hyder Ally in the black-hole at Calcutta, they were literally dying for want of air.⁵⁶⁰

The formulation of thinning prescriptions was slow to develop, and here again individual predilection governed procedure on the various private estates. Similarly, opinions differed on the advisability of pruning. In some places, trees of all species were so heavily pruned as to amount to lopping or shredding. Elsewhere pruning was practised in a more reasonable manner. For example, in 1811 the Rev. Sir Thomas Gery Cullum toured Wales, and in the Vale of Towy he recorded that:

"trees of all descriptions seem more taken care of in Wales than in England, a Pollard being hardly ever seen, & the trees are judiciously pruned, not like the trees in many parts of England like a Cabbage stuck upon a May Pole, or left with long stumps like the teeth of a rake.⁵⁶¹

Some people argued against unseasonable (i.e. spring) pruning of conifers, and some against any form of pruning on any species whatsoever.⁵⁶²

Early in the 19th century the choice of exotics was effectively limited to European and Eastern North American species (cf. Table 27), but as botanical exploration and collecting developed in new parts of the world, the acquisition and planting of exotic ornamental conifers from Western America, Asia and South America became fashionable on all the great estates of Wales. Dozens of different species were planted as individual specimen trees or as small clumps, and many published lists of these plantings giving botanical names (often incorrect or now obsolete) are available for various estates, e.g. Penrhyn Castle (Caernarvonshire), Hafodunos and Coed Coch (Denbighshire), Stanage (Radnorshire), Golden Grove (Carmarthenshire) and Stackpole Court (Pembrokeshire).⁵⁶³ These lists generally record the age, height, girth, crown diameter, and information on silvicultural characters such as wind resistance, frost hardiness, soil preference, etc. These early ornamental and park plantings of a wide range of exotic conifers proved valuable as species screening trials for commercial forestry. Most of the species tried proved unsuitable for commercial planting, but the performance of some species such as Douglas fir (Pseudotsuga menziesii), noble fir (Abies procera), Japanese larch (Larix kaempferi), Lawson cypress (Chamaecyparis lawsoniana) and Sitka spruce (Picea sitchensis) was such as to encourage trials at commercial planting.

The introduction and spread of the green (coastal) form of Douglas fir is interesting as an example of the development of a promising conifer species from the status of individual ornamental specimens in parks into one of the most important commercial conifers in forestry in Wales. Douglas fir was first introduced into Britain in 1827, and the earliest known plantings in Wales were as specimen park trees in 1840 at Penrhyn Castle (Caernarvonshire), in 1842 at Powis Castle (Montgomeryshire) and ca. 1845 at Stanage (Radnorshire). Fertile seeds were obtained quite early from the two trees in Penrhyn park, and sown in flower-pots. Attempts were made to grow some of the young plants in forest conditions, but because of the scarcity and cost of the planting stock it was necessary to make the plants go as far as possible by wide spacing and by planting among hardwoods and other conifers such as larch and spruce.

The young plants from the Penrhyn trees were planted out in Cochwillan wood among young oaks in a meadow alongside the river Ogwen in about 1854; one small enclosure was cleared of oak and a pure crop of Douglas fir was raised at a spacing of about 18 ft. In 1912, i.e. at age 66 years and with 119 trees/acre, the mean height was 101 ft., mean quarter-girth $17\frac{1}{2}$ in., and quarter-girth volume over bark $11,450 \text{ cu.ft./acre.}^{564}$ Other plantings of Douglas fir in hardwoods or other conifers were made in Caernarvonshire soon after the Cochwillan trial, and excellent growth rates were obtained:

<u>Site</u>	<u>Age</u>	<u>Height,ft.</u>	<u>Q.Girth,in.</u>
Dulasau (Betws-y-coed)	70	116	29
Bryn Derw (Bethesda)	60	97	19½
Moel-y-Ci (Tregarth)	43	67	10

On the Llandinam estate (Montgomeryshire) Douglas fir was planted in a number of plantations established in the 1880s. Here the practice was to plant 1 Douglas fir to every 3-5 larch, rows of pure larch alternating with rows of larch + Douglas fir. In Tyn-yr-wtra plantation, established in this way in 1884 with 1100 larch and 360 Douglas fir to the acre, the Douglas fir quickly outgrew and suppressed the larch, which was removed at age 18. At 38 years (in 1922) the mean height of the Douglas fir was 83 ft., standing volume 7470 cu.ft./acre, and m.a.i. 196 cu.ft/acre.⁵⁶⁵ Mensurational details of other early mixed conifer plantations containing Douglas fir in Montgomeryshire have been recorded by Llewelyn.⁵⁶⁶

In Wales the provision of shelter for dwelling-houses, livestock, field crops and for actual plantations was very important, both in the uplands and in areas exposed to sea winds. Planting for shelter had been recognized from very early times in the Welsh Laws, where a relatively high value was assigned to trees deliberately planted for shelter (cf. p.50). Considerable attention was paid to the optimum choice of tree species for shelter, and to the design and establishment of shelterbelt plantings in Idea Agriculturae⁵⁶⁷ and later in the reports submitted to the Board of Agriculture at the turn of the 18th century.⁵⁶⁸

Sometimes mechanical shelter was provided to give trees a start in very exposed places, e.g. stone walls, earth banks or mounds with wicker screens. Species recommended for shelter-planting in places exposed to the sea-winds were black poplar, abele (white poplar), sycamore, hop willow, mountain ash, birch, Dutch elm, English elm, plane, beech and ash, and as hedge plants brown or Welsh willow, bullace* and elder. In the uplands, the species recommended for shelter-planting included sycamore, ash, alder, birch, elm and Scots pine.

The best shape for plantations in exposed places was deemed to be:

parallelograms with their shorter sides to the west; by which means, the greater number would be protected with the loss of a few.⁵⁶⁹

Although the need for shelterbelts on upland farms was manifest, little shelter-planting was done in the uplands, and on most estates planting was confined to sheltered places with the aim of ensuring good growth of timber. The situation was expressed clearly by T. Davies, district surveyor of the Aberaeron highway district (Cardiganshire) in 1894:

What is wanted is systematic planting in long beltings along the high ridges of the county of hardy trees for shelter only, that cannot be cut down ... Some few landlords in the beginning of this century did a little of this, and it is astonishing to see the effect it has had on those neighbourhoods.⁵⁷⁰

* Prunus insititia L. (P. domestica L. ssp. insititia (L.) C.K.Schn.)

Constant severe exposure to winds either prevents growth completely or reduces it, and results in crown and stem distortion or premature mortality. The other form of wind damage is windthrow or wind-breakage of established trees. There are numerous documented instances of storm damage to trees and woods in Wales from very early times. On the night before Christmas eve 1236 many woods were 'rent' by a storm.⁵⁷¹ In the winter of 1628/9, three terrible gales (ryfilwnt arvthrol) in the Rhuthun area of Denbighshire uprooted large numbers of mature oaks.⁵⁷² At Mostyn (Flintshire) a great storm occurred on 15 March 1757:

Fe daflodd dros 100 o dderw Mostyn
i lawr, sef eu codi o'r ddaer ...
a'r coed ffawydd yr un modd, rhai
gwedi eu torri yn eu haner, eraill
gwedi eu codi o'r ddaear
(it threw down over 100 Mostyn oaks,
uprooting them ... and the fir trees
the same, some snapped in the middle,
others uprooted) ⁵⁷³

On 10 Nov. 1810 at Margam (Glamorgan) 81 large oaks were thrown by a storm.⁵⁷⁴ The great gale of 14 Oct. 1881 caused damage to trees of various species on estates from Carmarthenshire to Denbighshire and Caernarvonshire.⁵⁷⁵ The gale on 26 January 1884 caused serious damage to a second-generation larch plantation near Castle Madoc (Breconshire); it uprooted some 200 larch trees and snapped 12 at a height of about 6 ft. Some of these trees were growing on a spot where a previous larch plantation 60-70 years old had suffered extensive windthrow in a summer storm (July 1853).⁵⁷⁶

From very early times, trees were valued at fairly arbitrary fixed prices (cf. Table 6), and this pattern

persisted until at least the end of the 17th century, though increasing attention was of course paid to differentiation by size. On the Gwydyr estate in the 1680s, sales were generally by arbitrary prices for standing trees or parts thereof, though converted timber was sold by the piece in specified dimensions or by superficial measure (cf. p.166).⁵⁷⁷ In the early and mid 18th century, the trend was for standing trees to be individually numbered and measured, and their weight estimated, the timber generally being valued and sold by the ton or by the load. For example, the Margam estate (Glamorgan) valued timber by the ton in 1738 (cf. Tables 20 & 21), and at Golden Grove (Carmarthenshire) in 1757 the articles of agreement between the owner John Vaughan and Richard Chitty, timber-merchant from Sussex, specified the sale of 6620 trees, mainly oak, for £10,300; the price was 40s. per load or ton.⁵⁷⁸ Oak ship-timber was generally sold by the load* (cf. pp. 164-5).

However, the increasing professionalism of foresters and the importance of fast-growing plantations helped to promote an awareness of the need for accurate mensuration of volume and evaluation by measured volume instead of estimated weight. Measurement of cubic foot volume of timber became increasingly common towards the end of the 18th century, though of course cords of various sizes (cf. Table 16) continued to be used as the measure for smaller material.

* 1 load = 50 cu.ft.

Not until the end of the 19th century was girth (or diameter) measured at a standard height. In the 18th and 19th centuries, various estates measured their trees at 2 ft., 3 ft., breast-height (approx. 4 ft. 3 in.); 5 ft., or even 6 ft. above ground. Very large old specimen trees, especially oaks, were girthed at ground level and at about 5 ft. and often also at heights further up the stem. For example, a large oak at Cefnmabli (Glamorgan) girthed 21 ft. near the ground, 15 ft. at about 30 ft., and $11\frac{1}{2}$ ft. at 56 ft.⁵⁷⁹

Though the importance of rapid growth was becoming realized (cf. p.227), the measurement of volume increment was not well developed, and even recorded height measurements are often suspect. In the early plantings by Thomas Johnes at Hafod, the height increment of young European larch averaged ca. 2 ft. per annum (maximum annual shoot increment 3 ft. 8 in.), and radial growth rates were approximately 7-9 rings per inch; at 70 years some specimens contained 120 cu.ft., having produced about $1\frac{1}{2}$ cu.ft. (solid) per annum. A larch stand on the Hafod estate, planted about the year 1800 at an altitude of 1150 ft., was measured at age 115 years; its mean height was 73 ft., and the quarter-girth volume under bark was 4970 cu.ft. per acre.⁵⁸⁰ In 1865, one individual larch tree at Hafod was reported as being 160 ft. in height;⁵⁸¹ if correct, this would be a record for European larch in Britain, but the figure is not accepted by modern authorities.*

* A. Mitchell (Forestry Commission) personal communication; cf. A. Mitchell 'A field guide to the trees of Britain and Northern Europe'. 1974. p. 119.

In 1880, a park specimen of larch at Penpont (Breconshire), reputedly the largest in Wales, was girthed at 19 ft. 7 in. at the ground, and 13 ft. 10 in. at 3 ft. high; the maximum crown diameter was 106 ft., and the estimated crown projection was 980 sq. yards.⁵⁸²

English editions of Hoppus tables were available and were used in Wales, but during the 18th century several Welsh-language versions of Hoppus, or ready-reckoners and manuals based on it, were published*. These mensurational booklets are in fact the only technical instructions on forestry that have ever been published in the Welsh language. They contain standard Hoppus tables or extracts of tables, for measuring square and round wood appropriate to the sizes of trees found in Wales; some also contain instructions for measuring wood with the 'sliding rule', and for measuring the height of standing trees, e.g. with Gunther's Quadrant.

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- *1700. Anon. Cyfarwyddiadau i Fesurwyr (Instructions to Measurers). Shrewsbury.
1768. John Roberts. Arithmetic: mewn trefn hawdd ac eglur (Arithmetic in a clear and easy way). Dublin. (2nd ed. 1796).
1775. Mathew William. Y Mesurwr Cyffredinol (The General Measurer). Carmarthen. (2nd ed. 1785; 3rd ed. 1810).
1776. Lewis Morris. Rhoddd Meistr i'w Brentis (A Master's Gift to his Apprentice). Bala. (2nd ed. 1812).
1784. Anon. Cyfarwyddiad i Fesurwyr (Instructions to Measurers). Wrexham.
1816. Anon. Y Mesurydd Tir a Choed (The Land and Timber Measurer). Denbigh (3rd ed. 1858).
1830. William Griffith. Y Ddwy Droedfedd (The Two-Foot Rule). Caernarfon.

Some examples from the late 18th and early 19th century may be given to illustrate the development of forest mensuration and valuation in Wales, viz. on the Cawdor estate (Carmarthenshire), the Golden Grove estate (Carmarthenshire), the Corsygedol estate (Merioneth), the Taliaris estate (Carmarthenshire) and the Plymouth estate (Glamorgan).

On the Cawdor estate, coppice slangs* of cordwood were valued in 1790 by measuring the surface area of the slang (in acres, rods and perches) and estimating the expected yield in cords in the next coppice felling, e.g. 10, 12 or 18 long cords per acre. The cord was valued at 12 s., the bark at £4 per ton, and the 7 standards left per acre at the previous cutting were valued at 1 s. each.⁵⁸³

In 1812, trees at Llandybie (Golden Grove estate) were described as '59 trees 66 feet each at 3s. 6d. per foot being 77 tons at £8 15s. per ton'. This shows the dual form of measurement with values in cubic feet and in tons (50 cu.ft. to the ton).⁵⁸⁴

In a valuation of the timber growing on Corsygedol demesne and adjoining tenements early in the 19th century, detailed measurements and estimates were made for each individual (numbered) standing tree, viz. length (in feet), girth (in inches), content (volume in cubic feet), value per foot (in pence), total value (£. s. d.), amount of bark (tons, hundredweights, quarters), and amount of cordwood (in cords and feet). The timber value ranged from 12d. to 20d. per foot (generally 15d. or 18d.); the bark was

*Slang: a local dialect word for a strip of land.

valued at £9 per ton, and the cordwood at 10s. per cord. The timber was almost entirely ash and oak, and the total valuation was £4045 18s. 10d.⁵⁸⁵

On the Taliaris estate a valuation in 1838 showed careful distinction of species, and of tree-classes within a given species (Table 29).⁵⁸⁶

Table 29. Timber valuation on Taliaris Estate (Carms.) 1838

Tree species	Value per foot	
	s.	d.
Ash	1	9
Aspen		8
Beech		9 (or 1s.)
Birch		8
Cedar	3	0
Chestnut	1	0
Elm	2	0
Fir	1	0
Larch	1	3
Lime		8
Maple	1	0
Oak	1	9
Service		8
Spruce fir	1	3
Sycamore		8
Walnut	2	6

In addition to the oak timber, the amount of oak bark was estimated at 39 tons and valued at £2 15s. per ton. Young trees that had not reached the size of timber (8 inches girth and upwards) were called 'tellers' and were divided into one of six classes; these were valued per stem, by class, as follows:

Species	Class 1	Class 3	Class 6
Oak	5s.	-	2s. 6d.
Ash	5s.	4s.	2s. 6d.
Beech	4s.	-	2s. 6d.

The hardwoods (oak, ash, elm) were valued higher than the softwoods (spruce, fir, larch), in contrast to the situation obtaining just a century earlier, when the rarity of softwoods had made them more valuable than oak (cf. Table 21).

The typical sale valuation for Coed y Bowdra wood on the Plymouth Estate in 1833, detailed below (see p.264), also shows that measurement of cubic volume of standing timber was now standard practice, along with estimates of the amount of bark and cordwood.

Before 1800, instances of good management were exceptions rather than the rule, and there are few cases where the actual economics of forestry are given in any detail. One example is a 29-acre coppice oak wood with some ash in the vale of Aeron (Cardiganshire), which was bought in 1792 for £400. It was fenced, and the bark and wood from the thinnings 'paid periodically the interest on the purchase money, or nearly so'. The growth was 1-10 years in 1792. In 1809 one lot was sold for £750 and another in 1813 for £375; the remainder was valued at £500, i.e. a total of £1625 in 21 years from a piece of woodland bought for £400.⁵⁸⁷

The woods accounts of several Welsh estates are available, but usually for only short periods during the 19th century. The method of book-keeping varied, but a good general idea of the system is provided by the detailed analysis of the Plymouth Estate accounts (see p.262 et seq.).

By the end of the century, these simple economic calculations had been replaced by quite sophisticated economic forecasts including land rent, insurance, and compound interest. Muir, the Scottish forester in charge of the 2000 acres of forest trees on the Margam estate (Glamorgan), was one of the few professional foresters to give evidence to the Royal Commission on Land in Wales & Monmouthshire (1895). He was a strong advocate of European larch, thinned at 4- or 5-year intervals, on a 50-year rotation. To the Commission he proposed a scheme of State aid for forestry in the form of loans for planting, and a detailed statement of the economics of planting 100 acres by such a scheme, including all costs, rent, insurance and compound interest at 3%. The loan would be repaid, with compound interest, during the last 13 years of the rotation, and the estimated profit to the owner at the end of the rotation was calculated as being of the order of £100 per acre.⁵⁸⁸

Besides the major planting achievements (examples of which are listed e.g. in Table 28), most private estates in Wales sought to preserve and increase the stock of wood, especially hardwood timber, on the farms forming their estates. This was done in two main ways, viz. (1) by the exhortation and example of progressive landowners as exemplified by Thomas Johnes of Hafod (Cardiganshire), and (2) by compulsion through the insertion of planting clauses in leases. Planting clauses had been known since at least the 16th century (cf. p.131), but landlords invariably reserved all timber trees and usually all the underwood on their estates. With the development of leasehold tenure in Wales, it became general to operate short-term leases, and in many

cases leases from year to year. These short-term leases were by their very nature unsuited to the essentially long-term commitment involved in growing trees. Tenants in general were therefore deprived of security of long-term tenure and of any financial interest in timber existing on their land; moreover, on estates where planting clauses were in force the tenants were obliged to procure, plant and maintain trees without any possibility of deriving any eventual pecuniary benefit themselves.

The net effect was to create a situation where tenants had no interest in promoting sound long-term management of woods and trees, and indeed had much to gain by eliminating or abusing tree growth on their land. This emerges clearly from the first series of reports to the Board of Agriculture in the 1790s and the subsequent octavo reports, from the various counties of Wales.^{58?} These reports show that, in general, under the terms of the leases the landlord reserved the right to fell and carry off any timber, paying equitable damages, and to enclose and fence coppice and plantations, the annual value of the land so enclosed being determined and deducted from the rent. The terms of the leases required the tenant to prevent cattle or sheep from grazing in coppices, plantations, etc. set apart by the landlord, with a penalty (generally £5) for each offence; not to fell, shred (i.e. lop), top or otherwise damage trees, tops of pollards excepted, under a penalty (again generally £5 for each tree damaged); and not to permit other people to cut any saplings nor any kind of underwood (penalty generally £1 per sapling and 15s. per load of underwood). However, tenants were generally allowed to cut underwood needed for 'hedge boot'

and 'fire boot' (i.e. for repairing hedges and for fuel), though they were of course forbidden to sell any wood from the farm. A tenant farmer was therefore unwilling to raise a crop of young wood for his landlord's ultimate use, especially as he himself was already paying the landlord rent for the land. Accordingly tenants regarded trees and woods growing on their land as unwanted intruders, and took care to destroy all young plants, before they attained the age of 'timber' and would be reserved to the landlord. Any trees that did succeed in reaching maturity were surreptitiously lopped and topped; in Radnor these lopped and topped trees were known as rundles (i.e. pollards), and became the property of the tenant.

One method suggested to remedy this situation was to give tenants some financial interest in the well-being of trees and woods, as was the case in Ireland, where any lease-hold tenant acquired a legally enforceable financial interest in any timber trees he had planted on the land he occupied.⁵⁹⁰ This enlightened recommendation was not put into effect in Wales, but a more radical method of overcoming the neglect or abuse by tenants was practised in some areas, e.g. in the counties of Brecon and Radnor early in the 19th century. Here some landowners detached the woodlands from the farms to which they had belonged, and put them under the care and protection of woodmen (i.e. professional foresters), for proper fencing and management, including thinning and pruning.⁵⁹¹ Many estates recorded every timber-tree and painted its number on it in an effort to

stop abuses by tenants; tellers (i.e. saplings and young trees) in woods, fields and hedges were also paint-marked and counted in an attempt to deter tenants from abuses. On the Abbey Cwm Hir estate (Radnorshire) this measure was recommended in 1822 and had been implemented by 1833.⁵⁹²

Summaries of agreements and leases operative on over 100 estates in all parts of Wales in the final quarter of the 19th century are available.⁵⁹³ Analysis of these indicates that the leases were still generally of the same conservative and prohibitory nature as a century earlier, though some contained positive clauses requiring tenants to plant trees. The clauses relating to woods and trees in the leases tended to follow a general pattern very similar to that outlined above for the early part of the century. The following selection of more detailed or specific clauses in force on Welsh estates large and small indicates the typical constraints imposed on the tenants as regards utilization of trees, the penalties specified for infringements, and the obligations for care and maintenance of existing trees and woods, and for new planting. The tenants were required:

'not to lop any trees higher than they have been usually lopped, and to preserve all trees and saplings' (Craigydun, Anglesey);

'the tenant shall protect all trees, plantations, brushwood, underwood' (Wynnstay, Merioneth);

'to preserve all timber, growing trees, and underwood, not to lop any tree or sapling under a penalty of £10 for each tree or sapling' (Rhiwlas, Merioneth);

'not to cut down, top, lop, or prune any timber tree, pole, or underwood ... pay the sum of £10 in respect of each tree or pole which may be cut down or destroyed ... in addition to the value of such tree or pole' (Mostyn, Flint);

'£5 for every tree, holly bush, or sapling cut or injured, or for growing timber into which nails are driven' (Brynkinallt, Flint);

'whenever the tenant shall new lay or cut any hedge or fence, he shall in all cases leave one timber tree or sapling of oak, ash, elm, or alder, a standard at every 25 feet distance; and in case there shall be no such tree or sapling growing ... the tenant shall ... procure and plant therein, at his own expense, at the distance of 25 feet apart, good and healthy saplings of oak, ash, elm or alder' (Taliaris Park, Carmarthenshire);

'to preserve all trees, fruit trees, timber trees, imps, saplings, and pollards now growing or hereafter to grow' (St. Athans, Glamorgan);

'not to cut down, crop, or shred any timber tree, sapling, pollard, fruit or other tree or trees under a penalty of three times the value of such timber trees, and £10 for each of the said other trees, but to preserve all timber trees, saplings, or pollards, and also all fruit trees, and not to cut any sally or alder but for the use of the farm, and at the proper seasons of the year' (Duke of Beaufort, Monmouthshire).

Game was another source of friction between landlord and tenant in Wales. Although the larger woodland game animals such as red and roe deer had become extinct in the wild, the interests of most estates in ground game, game birds and foxes took precedence over forestry in the later part of the 19th century. Much estate planting was primarily for the establishment or renewal of game coverts, generally mixtures of hardwoods and softwoods. The planting stock was sometimes topped to promote bushy growth, and evergreen shrubs such as rhododendron or privet were introduced, together with individual specimens or clumps of Norway spruce, silver fir or Douglas fir to create good dry shelter for the game birds.

Many estates regularly employed women and boys as well as men for forestry work. Women worked e.g. at planting, nursery work, cleaning and weeding, and bark-stripping. Woods labour was usually employed by the day, and women's wages were about half those of men. Typical daily wage rates in the middle of the 19th century on the Stradey estate (Carmarthenshire) in 1846-55 were 1/6d. for men and 9d. for women, and on the Hafod estate (Cardiganshire) in 1857 2/3d. for men and 1s. for women.⁵⁹⁴ In peak periods, e.g. the barking season, wage rates were often 50% higher than at other seasons.

On a well-managed Welsh estate that cared for its woodlands, the typical year's work of the forest-manager and forest-labourer in the last quarter of the 19th century, before the disappearance of the oak-bark harvest, was as follows:

January. Fell timber, thin and cut underwood; dispose of produce as early as possible, getting timber out before the sap starts rising. Measure produce preferably before removal from plantations. Plant only on driest and warmest sites. Cut and remove all hedgerow timber.

February. Finish planting deciduous trees wherever possible. Finish thinning all hardwood plantations except oak. Bind and stack faggots. Remove and transplant young stock in nursery. Young oak may need careful root pruning. Prepare land for planting by ploughing, draining, etc.

March. Beat up plantations 2-3 years old. Remove and transplant spruce, privet and other evergreens to old and sheltered plantations for game cover. Young fir and pine plantations can be thinned up to end of month. Fill up nursery with young plants. Finish planting trees of all sorts.

April. Firm in recently planted trees, if blown about by wind. Get tools etc. ready for oak bark stripping, which can start if the weather is mild and warm. Finish thinning of young plantations. Continue transplanting evergreens in nursery.

May. The main job is stripping and harvesting of the oak bark. Erect drying ranges in the plantations, or on rides, and put bark outside upwards. Check young plantations and newly transplanted trees, and straighten if necessary. Dig, hoe and clean between plants in nursery.

June. Bark stripping now completed. If bark not sold, protect it against wet weather. Dress all the oak timber and remove it carefully. Cord all branches for sale, or for firewood, charcoal etc. Prune hardwoods (lightly). Clear gorse, grass, etc. from young plantations. Start site preparation for next planting season.

July. Finish dressing oak timber after peeling. Finish pruning hardwoods. Clear gorse, grass etc. from young plantations. Hoe and weed in nursery. Mow and clean in pleasure grounds. Keep walks and carriage drives clean. Continue site preparation (clearing, draining, fencing, etc.).

August. Little forest work done because most staff are released for harvest work. Continue preparation of mountain ground for planting.

September. Same as August.

October. Continue enclosing and preparing ground for planting. On dry or drained sites, plant towards end of month. Thin young softwood plantations, but defer thinning hardwoods till end of month. Continue pruning. Select nursery stock for planting; it should be 'well-feathered, clean and matured in its growth.'

November. (a busy month). Continue planting, fencing and thinning. This is one of the best months for tree planting. Thin plantations, after they have been shot through. Protect new plantations against rabbits and hares. Mark hedgerow trees for felling. Continue enclosing and preparing ground for planting.

December. Continue fencing, draining, clearing and preparing ground, and planting. Continue thinning plantations and cutting underwood. Fell and dispose of hedgerow trees (except oaks). Check drains and fences.⁵⁹⁵

A few published studies have made passing mention of forestry on individual Welsh estates in the 18th and 19th centuries, e.g. Duffryn Aberdare (Glamorgan),⁵⁹⁶ Corsygedol (Merioneth)⁵⁹⁷ and Golden Grove (Carmarthenshire).⁵⁹⁸ Detailed studies, mostly unpublished, of forestry activity have been made for a few Welsh estates, viz. Baron Hill (Anglesey),⁵⁹⁹ Hafod (Cardiganshire),⁶⁰⁰ Crosswood and Nanteos (Cardiganshire) and Dunraven (Glamorgan),⁶⁰¹ and

the Glamorgan portion of the Plymouth estate (see below, p. 253). From these studies of individual Welsh estates and general surveys of British forest history,⁶⁰² it is possible to derive a generalized summary of forestry on private estates in Wales during the 19th century, against the general agricultural and socio-political background.⁶⁰³

The first two decades of the century, affected by the Napoleonic Wars, were a period when very high prices were obtained for wood and bark, and considerable investment went into forestry for the establishment of commercial plantations, and also for the creation or embellishment of park landscapes. In general, forestry was regarded by the larger landowners as a sound economic investment in the first quarter of the 19th century. Forestry and in particular the associated sporting interests of landowners were contributory causes in the deterioration of relations between landlords and tenants in Wales, which reached their nadir in the poverty and riots of the 1840s but continued to be generally poor thereafter. From the middle of the century the oak-bark trade declined and virtually disappeared (cf. Fig. 9), and the market for naval oak timber received its death-blow in 1862 when, at the battle of Hampton Roads, iron ships proved decisively superior to wooden men-of-war. Though the demand for pitwood was large and increasing, the improvement of the infrastructure (roads, canals and railways) and the systematic application of the Free Trade policy from 1846 onwards meant that unlimited cheap imports of softwood (round and sawn) could become

available in all parts of Wales, and commercial forestry at home became relatively unprofitable. In Wales many landlords, often absentee landlords, came to regard woodlands as game covers, and preferred 'poverty with a gun on its shoulder to competence with no rabbits on the land'.⁶⁰⁴ In the great agricultural depression of the final quarter of the 19th century, most of the big estates in Wales started to experience financial difficulties. From ca. 1870 onwards, these difficulties resulted in the break-up of estates and the growth of freehold farming. This caused a general collapse of economic investment in woodlands towards the end of the 19th century and at Crosswood, for example, by 1900 the woods were regarded as an economic liability. Despite this, arboriculture flourished, and on a few estates some silvicultural experimentation was practised. During this period too the call grew for government support to private forestry, and for state involvement or commitment in forestry, i.e. a national forest policy, professional education and training in forestry, and development towards a state forest service (see below, p. 286 et seq.).

2. Forestry on the Plymouth Estate (Glamorgan)

The Glamorgan portion of the Plymouth Estate was selected for detailed study for the following reasons:

- i) the estate was large and important, and had a fairly stable history from the 18th to the 20th century;
- ii) commercial forestry on the estate was generally typical of that on other estates in South Wales, and in addition the estate carried out some interesting experimental work in silviculture;
- iii) quite detailed documentary evidence for forestry on the estate is available from 1766 onward (comparable records exist for very few estates in Wales⁶⁰⁵);
- iv) both fieldwork and access to the documentary material were convenient;
- v) no previous attempt had been made to assess either the economy of the estate in general or the forestry activity in particular.

The Plymouth Estate lies only partly in Wales, and consists of extensive areas in Glamorgan and in English counties along the border of Wales. A statistical survey of major landowners throughout Britain gave the following corrected figures for the whole estate in 1883 (Table 30).

Table 30. The Plymouth Estate in 1883.⁶⁰⁶

County	Area, acres	Annual value, £
Glamorgan	17,353	35,136
Salop	11,204	14,453
Worcester	8,530	13,574
Flint	327	589
Hereford	40	26
Total	37,454	63,778

Accordingly, the lands in Glamorgan formed just under half of the total area of the estate, but accounted for well over half its annual value. The nucleus of these lands in Glamorgan had been created by the union of two estates, Van and Saint Fagans, in 1616, when Sir Edward Lewis (of the Van) acquired the estate of Saint Fagans by purchase. The lands came eventually to the Plymouth Estate in 1730 as a result of the marriage of Elizabeth Lewis, only daughter and heiress of Thomas Lewis (of Soberton, the Van and Saint Fagans) to Other Windsor, 3rd Earl of Plymouth (1707-1732). The estate has since remained in the hands of the Windsor and Windsor-Clive family, in direct descent from this marriage.⁶⁰⁷

The most convenient starting point for the study of forestry on the Plymouth Estate is 1766, when a detailed survey was made by John Eyre of all the lands in the Glamorgan portion of the estate. The results of the survey are recorded in five large bound volumes of maps and lists, giving the name and area of each individual field and piece of woodland.⁶⁰⁸ A summary of the total area of the estate and the area of woodlands is given in Table 31.

Table 31. Woodlands in the Glamorgan portion of the Plymouth Estate in 1766.

Manors and lands (spelling modernised)	Total area acres	Woodland area acres	Woodland %
Manors of St. Fagans & Penhefyd; lands in parishes of Radyr and Llandaff	4,566	246	5.4
Manors of West Llantwit & Corntown; lands in parishes of Wenvoe, Llantrisant & Llantwit Fardre	1,874	144	7.7
Lands in parishes of Llanishen, Lisvane, Rudry, Bedwas, Eglwysilan & Llanfabon	5,191	1,144	22.0
Lands of parishes of Merthyr Tydfil, Aberdare & Llanwonno	5,687	1,213	21.3
Manor of Penarth	696	118	16.9
Total	18,014	2,865	15.9

Comparison of the total area in 1776 (18,014 acres) with the figure for 1883 (17,353 acres) shows that the area of the estate had remained relatively stable for well over a century. In 1766, the estate carried nearly 3,000 acres of woodland, excluding hedgerow trees and small clumps in corners of fields. Very few pieces of woodland were described merely as wood. In nearly every case, the land-use of the woodland areas was recorded as 'pasture and wood', or sometimes as 'herbage and wood', 'meadow and wood' or 'arable and wood'. Therefore, livestock grazing was obviously an integral part of woodland management almost everywhere, and arable crops were apparently sometimes grown under a sparse or open stand of trees.

The names of all the woods are given, in English and/or Welsh, but generally the names do not indicate either the system of management

or the species composition, with the exception of alder groves which were regularly called Arles (Welsh Gwern), usually with a qualification describing size or colour (e.g. black, blue or red). Two field names record beech in Eglwysilan parish (Kae Fuwyddan and Kae Fuwyddan Isha); oak occurs as a name element only very occasionally in Merthyr Tydfil parish (Dan-y-derry and Graige y Derry); and a few wood names incorporate the element for birch (bedw). It is safe to assume that the majority of the woods on the estate in 1766 were mixed hardwoods with oak predominant, and that much of the woodland was coppice. There is no evidence in the survey for any plantations, and certainly not for any conifer plantations.

The vast majority of the woodlands on all parts of the estate were small blocks less than 20 acres in extent and generally less than 10 acres. Only seven woods were over 50 acres in extent:

Coed Kae (Merthyr Tydfil parish)	61 acres
Furzy Field (Kae yr Ithynog, Rudry parish)	64 "
Great Van Park (Bedwas parish)	79 "
Black Arles (Gwern Ddu, Eglwysilan parish)	81 "
Graige Ycha (Merthyr Tydfil parish)	82 "
Graige y Derry (Merthyr Tydfil parish)	87 "
Castle Graige (Merthyr Tydfil parish)	171 "

The main areas of woodland on the estate lay chiefly in the upper part of the Taff valley (Merthyr Tydfil parish) and in the Van/Caerphilly/Bedwas area. The forestry operations on the estate, i.e. felling, planting, etc., were later organized accordingly, in three separate 'districts', viz. the Merthyr District, the Caerphilly District, and the Saint Fagans District. The small woods surveyed and recorded in 1766 in the less well wooded parts of the estate around the family seat of Saint Fagans and in the parish of Radyr have for the most part survived as part of the Plymouth Estate to the

present day, carrying the same names and with similar boundaries. Most of the other parts of the Glamorgan portion of the estate, including the woodlands, have been disposed of by sale or by leasing during the 20th century.

The general management of the whole Plymouth Estate during the 19th century was in the care of a succession of agents or stewards based at Barnt Green (Worcestershire), viz. John Maughan, James Tomson, and James J. Tomson. The Glamorgan portion of the Plymouth Estate was administered by local agents, viz. William Robson (1820s and 1830s), Thomas Goddard (1840-1875) and Robert Forrest (1875-1910). Until 1878 the agent at Barnt Green had general oversight over the local Glamorgan agent at Saint Fagans, but in 1878 (when the then Lord Windsor came of age) the Glamorgan portion of the Plymouth Estate was removed from the charge of the Barnt Green agent, and Robert Forrest assumed complete control over the Glamorgan properties.⁶⁰⁹ Robert Forrest was a Scotsman, who became a local JP and High Sherriff of Glamorgan. The men in charge of the Glamorgan woods were generally called woodwards and were responsible to the local (Glamorgan) agent, and until 1878 through him to the Barnt Green agent.

There was a general trend towards concentration of authority over the woods during the 19th century. In the 1820s, separate local woodwards were employed, e.g. at Saint Fagans, Radyr, Rudry, and Eglwsilan. These woodwards received a fixed annual sum in virtue of their office, plus extra amounts for various works done, e.g. in 1825 William Morgan was paid

£10	as woodward of Eglwysilan
£ 8 8s.	for carrying wood
£26	for paying workmen
£24 17s. 8d.	for gathering and planting acorns. ⁶¹⁰

From the middle of the century, the estate employed fewer woodwards but on a more professional basis and responsible for larger areas, e.g. in 1850 Daniel Williams received £42 as salary for his office of woodward to the Merthyr District and William Morgan £50 as woodward of the Caerphilly District.⁶¹¹ In 1865 William Williams was woodward of the Merthyr and Aberdare District at an annual salary of £30, and William Morgan was still woodward of the Caerphilly District at a salary of £50.⁶¹² The estate concentrated the supervision of the woods in the hands of a single woodward at the end of 1865. On Christmas Day 1865 William Williams formally accepted the post of woodward for the Merthyr, Aberdare and Caerphilly Districts at a salary of £100 per annum 'he paying all expenses'. In his letter of acceptance he wrote:

my Utmost Effort will be to Give full Satisfaction in my Agency by Adhering to the Golden Rule, of Watching and Superintend[ing] the interest of the Right Hon^{able} the Baroness Windsor as if the Estate had been my Own⁶¹³

However, the terms of Williams' office were later revised, and in 1872 his salary as woodward of the Merthyr, Aberdare and Caerphilly Districts was £50.⁶¹⁴

Small sums such as £1 per year were also regularly paid to people for 'looking after the woods' or 'looking after the young plantations' at various places on the Plymouth

Estate. These payments were in the nature of a 'retainer' to a local resident for keeping a general eye on the woods and plantations near his home, and reporting any trouble to the official estate staff.

The labour force varied both seasonally and from year to year, depending mainly on the amount of work involved in plantation establishment, fellings and bark stripping.

The income from the woods, and the expenditures on woods and plantations are contained in the Glamorgan Accounts and the Steward's Accounts.⁶¹⁵ Table 32 gives details of annual income, expenditure, and the balance for the period 1821-1881, with the exception of the years 1822, 1824, 1840 and 1877-1880, the accounts for which have not survived.

Table 32 shows that of the 54 years for which accounts are available, the woods showed a healthy book profit in 45 years, and a book deficit, generally small, in only 9 years. The income from the woods fluctuated considerably, but annual expenditure on the woods was much more constant, generally amounting to between £400 and £800 per annum.

The importance of the woods in contributing to the total income of the Glamorgan portion of the Plymouth Estate is shown as a percentage in Table 33, for selected years at approximately 5-year intervals. This table also shows the expenditure on woods and plantations as a percentage of total estate expenditure for the same years.

Table 32. Income from and expenditure on woods in the Glamorgan portion of the Plymouth Estate, 1821-1881.

Year	Income from woods			Expenditure on woods & plantations			Balance		
	£	s.	d.	£	s.	d.	£	s.	d.
1821	1476	16	3½	530	3	1½	+	946	13 2
1823	975	3	4	888	0	5½	+	87	2 10½
1825	1678	7	0	747	11	10	+	930	15 2
1826	246	9	6	809	10	11	-	563	1 5
1827	1158	18	1	380	12	9½	+	778	5 3½
1828	1576	4	4	1028	0	8	+	548	3 8
1829	2822	6	3	991	14	5½	+	1830	11 9½
1830	2395	0	9	1167	15	6	+	1227	5 3
1831	1958	13	11	904	18	1½	+	1053	15 9½
1832	1432	13	4½	761	1	10	+	671	11 6½
1833	812	16	1½	674	10	1	+	138	6 0½
1834	795	11	0	320	6	11	+	475	4 1
1835	469	11	10	476	12	6	-	7	0 8
1836	492	3	11	691	3	4	-	198	19 5
1837	2817	16	3	925	3	2	+	1892	13 1
1838	413	15	7½	348	1	7	+	65	14 0½
1839	397	3	2	404	19	6	-	7	16 4
1841	1779	8	0½	472	2	5½	+	1307	5 7
1842	966	6	10½	469	18	10½	+	496	8 0
1843	670	6	7	283	3	4	+	387	3 3
1844	797	0	3	186	19	11	+	610	0 4
1845	326	0	0	203	1	0	+	122	19 0
1846	1394	11	8	484	19	3½	+	909	12 4½
1847	862	4	7½	372	11	2	+	489	13 5½
1848	787	15	5½	328	0	8½	+	459	14 9
1849	2004	6	8	627	0	1	+	1377	6 7
1850	2855	2	6	953	1	9	+	1902	0 9
1851	2871	10	9	925	6	8½	+	1946	4 0½
1852	3703	8	9	1017	4	4	+	2686	4 5
1853	2474	9	4	887	16	5	+	1586	12 11
1854	3638	5	4½	1110	16	1	+	2527	9 3½
1855	3260	12	9½	830	14	11½	+	2429	17 10
1856	2349	4	3	693	9	9	+	1655	14 6
1857	2277	12	7½	899	9	3	+	1378	3 4½
1858	2319	5	4½	757	5	3	+	1562	0 1½
1859	1260	10	1	953	14	7½	+	306	15 5½
1860	1647	13	6	779	12	5½	+	868	1 0½
1861	3273	0	8	876	17	0½	+	2396	3 7½
1862	2079	14	10	776	12	9	+	1303	2 1
1863	1619	1	3	859	2	1	+	759	19 2
1864	2207	6	1½	797	4	10	+	1410	1 3½
1865	2513	18	9	712	3	0	+	1801	15 9
1866	1523	10	2	531	15	8	+	991	14 6
1867	125	15	4	504	19	10	-	379	4 6
1868	195	2	6	525	0	6	-	329	18 0
1869	1379	14	1	574	10	11	+	805	3 2
1870	524	1	9	485	19	1½	+	38	2 7½
1871	505	13	7½	572	11	11½	-	66	18 4
1872	2272	10	2	426	15	9	+	1845	14 5
1873	63	2	3	479	13	6½	-	416	11 3½
1874	2	0	0	478	6	4½	-	476	6 4½
1875	811	17	0	650	19	11	+	160	17 1
1876	3405	0	0	642	17	0	+	2762	3 0
1881	3717	12	0	1034	17	5	+	2682	14 7

Table 33. Total income and expenditure on the Plymouth Estate (Glamorgan) for selected years 1821-1881, and woods income and expenditure as percent of total.

Year	Total estate income £	Woods income as % of total income	Total estate expenditure £	Woods expenditure as % of total expenditure
1821	10,300	14.3	2,632	20.1
1826	12,156	2.0	2,708	29.8
1831	13,225	14.8	3,482	25.9
1834	12,138	6.5	2,742	11.6
1841	15,673	11.3	4,871	9.6
1846	16,360	8.5	4,344	11.1
1851	20,388	14.0	6,889	13.4
1855	26,914	12.1	9,665	8.5
1861	28,211	11.6	7,549	11.6
1866	27,302	5.5	7,294	7.2
1871	35,883	1.4	7,182	7.9
1874	35,449		8,465	5.6
1881	37,187	9.9	21,925	4.7

The main sources of estate income were rents from tenants, and royalties from collieries, quarries, etc. The woods contributed ca. 10% of the total income of the estate. The main expenditures of the estate were repairs to property and incidentals. In the early part of the century, the expenditure on the woods and plantations formed a high percentage of the total outgoings of the estate (over 20%), but this percentage declined thereafter to values generally below 10%.

The main expenditure on woods and plantations was for salaries and wages of supervisory staff and labourers; other expenses included sums spent on advertising wood for sale, auctioneers' charges, purchase of planting stock, payment of tithe rents, payments to mole-catchers, expenses on beer for workmen, etc. etc. The labourers were employed on the whole range of forestry activities typical of a

large private estate: walling, ditching, draining, site clearance for planting, fencing, planting, looking after young plantations, weeding, cutting gorse, marking and painting trees, measuring wood, felling, cross-cutting and cording wood (pitwood, cordwood, cogwood, charcoal-wood), barking, hauling, etc. Expenditures associated with barking (stripping, drying, weighing, loading and hauling) and with the preparation of pitwood, cordwood, etc. were greater in the first half of the century than later; during the second half of the century the bark trade slumped (see below, p.275), and the sales of wood were often arranged so that the buyers and not the estate woods staff were responsible for the felling, cording, etc. The accounts also clearly reflect the change in the woods operations with the growing industrialization of Glamorgan during the 19th century: in the 1820s and 1830s, besides the timber, pitwood and cordwood the expenditure accounts also contained many items indicating typically rural or small-scale craft uses such as cutting wattling, lopping oak, stripping oak bark, and the cutting of boat knees, whereas later on the accounts are completely dominated by sales of pitwood and cordwood.

Details of individual sales and fellings are contained in the Glamorganshire Wood Account Books of the Plymouth Estate,⁶¹⁶ four volumes covering the periods 1825-35, 1835-52, 1852-83, and 1883-1905. The Wood Account Books show five classes of entries: Timber Sold; Timber Used on the Estate; Pitwood Sold; Cordwood Sold; and Bark Sold. All wood sales are recorded in the account books. In the early years, the majority of sales were small ones, and in aggregate the many small sales brought in more revenue than the few large sales. Table³⁴ gives details of the main large sales (value over £100) from the Glamorgan

portion of the Plymouth Estate in 1825-52.

Table 34. Major sales of wood, Plymouth Estate, 1825-1852.⁶¹⁷

Year	Species and place (original spelling retained)	Value £
1825	oak; Wain Wylt	377
1826	oak; Coed cae Bant	257
"	oak; Pentre Bane	127
"	oak; St. Fagans	153
1829	oak; Park Wood, St. Fagans	197
"	oak; Llanvabon	109
1830	oak; Craig Shop	170
1835	oak, sycamore, ash, beech, oak cyphers*, & poles; Radyr, Lisfaen, Llanishen etc.	980
1837	oak; Llanwonno	242
1839	timber; Aberdare	825
1839	ash, oak, elm; Radyr & Pistilgola	140
1849	oak; Dan y derry	162
1852	beech; Ffawyddog	100

* cyphers - a term used for thin or otherwise inferior stems included in a sale along with the more valuable stems.

These fellings were all hardwoods, and mainly oak. Oak was being established by direct-sowing of acorns, e.g. at Saint Fagans, Pentrebane, Rhydlafar, Garth Wood and Ely Wood in 1826,⁶¹⁸ but planting of conifers, especially European larch, started in the early part of the 19th century, and continued throughout the century. For example, in 1829 the estate bought 20,000 larch plants from Andrew Monro for £22 6s. 6d.; in 1850 and 1852 the estate paid £31 13s. 6d. and £26 17s. 6d. respectively for larch plants from Maule & Co., commercial nurserymen; and in 1881 the estate spent £343 12s. 9d. on plants including larch and Scots pine from the firms of Treseder and Dickson.⁶¹⁹ Sometimes the estate sold off small amounts of surplus larch planting stock, e.g. 2,000 plants in 1867 at 30/- per 1,000, and 1,200 plants in 1868 at 2/6d. per 1,000.⁶²⁰ From the 1850s onward, sales of larch wood assumed increasing importance.

As on most estates in Wales, larch remained the main conifer planted in the commercial woods of the estate throughout the 19th century. Relatively small amounts of Scots pine and Norway spruce were planted in the second half of the century.

From about 1850 onwards, the estate tended to organize its woods operations so as to have fewer but larger sales. Whole woods or parts of woods were measured, valued and sold at auction. Some agreements specified price 'per foot cubic string measure', with measurement jointly by representatives of the buyer and vendor.⁶²¹ The sales were generally held in November, and the conditions of sale were specified in standard printed forms (see Fig. 8).

Woods were valued before sales. A typical example of a valuation is one at Coed y Bowdra Wood (Rudry) in 1833:⁶²²

638 oak timber trees = 12,603 ft. at 3/6d. per foot, including lop, top & bark	£2,205 10s. -
57 beech trees = 890 ft. at 1/- per foot, including lop & top	£ 44 10s. -
Total	£2,250 - -
300 oak cyphers* = 15 short cords of pitwood at 9/- per cord	£ 6 15s. -
Bark of ditto, say 3 tons	£ 15 - -
Say 20 cords of White wood cyphers* at 10/-	£ 10 - -
Cordwood exclusive of timber & cyphers, 150 cords at 4/-	£ 30 - -
Total	£ 61 15s. -
Deduct tithe of Cordwood	£ 5 - -
	£ 56 15s. -
Grand total valuation	£2,306 15s. -

*Cyphers are inferior stems, i.e. non-timber trees; white wood cyphers are inferior stems of species other than oak.

CONDITIONS OF SALE.

- 1..... The highest bidder to be the purchaser; and if any dispute arise between two or more bidders the lot shall be put up again.
- 2.....No person to advance less than _____ at each bidding under _____; and at each bidding above _____
- 3..... _____ in part of the purchase money, shall be paid to the seller's agent, immediately after the sale; and the purchaser of each lot shall, within ten days afterwards, give such security as shall be approved of by the seller, for the payment of the remainder, viz. half on the _____ next, and the other half on the _____ and the expenses of such security, as well as of the agreement of sale, shall be paid by the purchaser.
- 4.....The trees in the woods and coppices shall be axe fallen or sawn down, and taken out of the same on or before the _____ and whatever timber, pit wood, cord wood, or other part of the purchase, may be left in the said woods and coppices after that time, shall be deemed and taken as the property of the seller.
- 5.....The trees on the farms shall be fallen and removed to some convenient place, on or before the _____ which place shall be appointed by the seller's agent; and whatever timber, pit wood, cord wood, or other part of the purchase may be elsewhere found upon the farms after that time, shall be absolutely forfeited to the seller. And from the place appointed by the agent, the whole shall be taken away before the _____ day of _____
- 6.....The purchaser to be permitted to use all accustomed roads, to and from the above-mentioned woods, coppices, and farms; and if any trees are felled across any road, the purchaser of them shall remove them out of the way, so as not to obstruct or hinder the purchaser of any other lot, in removing his timber, &c.
- 7.....Any unnecessary damage, whether proceeding from accident or carelessness, shall be fully compensated for, to the parties sustaining it.
- 8.....In case any purchaser shall neglect, or refuse, to comply with the foregoing conditions, the deposit money shall be forfeited, and the timber resold; and if any loss shall happen to the seller, from such second sale, then the same shall be made good by the purchaser at this sale, so neglecting or refusing.

Fig. 8. Copy of 'Conditions of Sale' form used on the Plymouth Estate in the 19th century.

Table 35. Major sales of timber; pitwood, cordwood and coppice from Plymouth Estate woods (Glamorgan), 1853-1905. 623

Year	Type of produce	Name and location of wood (original spelling retained)	Area, acres	Value, £
1853	wood	Graig	29	230
		Coedygove	17 }	500
	wood	Great Wood	11 }	570
	"	Gelly Hirrion	13	480
	"	"	10	205
	coppice	near Bridgewater Arms	8	550
	"	Ely Wood	17	870
	"	Gellyhirrion Wood	15	380
	"	Troedyrhiew Wood	12	
1854	coppice	Gellyhirrion	21	1,070
	"	Ely Wood	15	325
1855	coppice	Coedcaemawr, Llanvabon	23	550
	"	Graig, Eglwysilan	8	445
	"	Graig-y-Lysi, Merthyr	18	1,010
1856	coppice	Hendredenny Wood		615
	"	Court-y-laga Wood, Bedwas		100
	"	Dan-y-derry		240
	"	various farms		295
	"	Wallace Wood		400
1857	larch; pit + cordwood	Wernddu, Caerphilly	30	700
	100 oak, ash, beech, + pit + cordwood	Castell Lloyd farm, Lanvabon		255
1858	larch; mixed pit + cordwood	Wernddu, Caerphilly	45	1,205
	larch	Maenllwyd Wood, Rudry	5	235

Table 35 (contd).

Year	Type of produce	Name and location of wood (original spelling retained)	Area, acres	Value, £
1859	pitwood + coppice larch larch + pitwood pit + cordwood larch etc, " "	Wernddu, Caerphilly Wernddu, Caerphilly Wernddu, Caerphilly Treboth Wood Graig yr Allt Danyderi, Troedyrhiew	17 6 7 13 6 25	570 470 270 180 170 480
1860	timber larch etc. wood + timber " " larch etc. " "	Dan y derri Cae Twyn Wood, Rudry Cwmbargoed Valley, Merthyr Quakers Yard Maenllwyd Wood, Rudry } Wernddu, Caerphilly	9½	250 255 620 410 785
1861	oak pitwood etc. " " oak timber pitwood, coppice	Tynypark Wood, Aber valley Tairwain Wood, Llanvabon Forest Vawr Farm Rhydlafer	30 4 5	770 100 275 145
1862	mixed wood " " oak timber larch + coppice " "	Coedpenmain Rhydlafer Cwmbargoed Valley Rudry Wood, Rudry Wernddu, Caerphilly	8 19 11 15	145 290 310 320 135
1863	pit + cordwood " " " "	Gelli Wood, Llanwonno " " " " " " Wood near Maenllwyd, Rudry	14 17½ 11 13½	730 880 500 485

Table 35 (contd).

Year	Type of produce	Name and location of wood (original spelling retained)	Area, acres	Value, £
1864	pit + cordwood	Coed y Bowdra, Michaelstone	11	380
	"	"	14	360
	"	Gate y du Wood, Eglwysilan	19	650
1867	"	Gelli Wood, Llanwonno	18	415
	"	Wernddu Wood, Caerphilly	40	900
1868	larch	Wernddu Wood, Caerphilly	2}	
	pit + cordwood	Craig-Llan Wood, Rudry	6}	180
	"	Wernddu Wood, Caerphilly	11	275
1872	larch	Maenllwyd Wood, Rudry	46	2,178
1875	pitwood	Dan y derri		
		Castell Llwyd		
		Wernddu		1,464
	larch	Rudry		1,200
	larch; coppice	Copper gwuthe Wood, Rudry	20	660
	"	"	27	900
	"	"	22	600
1876	coppice	Forest Newydd Wood, Pontypridd	73	2,044
	579 oak trees	"		1,050
1877	timber	Forest Newydd Wood, Pontypridd		224
	oak trees	Pentre Wood, Treforest		395
1879	coppice	Cwm Leyshon		1,097
1880	coppice	Coed y Gof, St. Fagans	13	205
	pit + cordwood	Quakers Yard Wood, Merthyr	21	
	coppice	Craig Llanishen, Llanishen	40	
	"	Forrest Newydd Wood, Pontypridd	71	3,650

Table 35 (contd).

Year	Type of produce	Name and location of wood (original spelling retained)	Area, acres	Value, £
1883	oak trees " " wood	Forrest Newydd Wood, Eglwysilan Quakers Yard & Pontygwaith Ystradmynach Wood } Pontygwaith Park y Van Wood, Rudry Craig y Shenkin Wood, Rudry Cae ty du Wood, Eglwysilan Tyla Fedw, Llanwonno Buarth Capel Wood, Llanwonno Plymouth Wood, Llandaff Hendredenny Wood, Eglwysilan Gelly Wood, " Craig yr Allt, " Rhydflaver, Maerdy & Tranch wood Garth Wood + 4 brakes, Radyr St. Fagans & Pentyrch Ely Mill Rudry & Van Parc y Van Wood, Rudry Craig y llan Wood, " Wernddu Wood, Van Craig y Llyssi Wood, Merthyr Wernddu Wood, Bedwas Coed y gof Wood, St. Fagans	21 7 21 14 17 34 72 39 11 33 4½ 42 27 36½ 29¾ 17 22½ 6	635 230 445 625 200 710 500 1,050 1,360 1,484 890 638 1,950 360 600 530 405 540 120
1884				
1885				
1888				
1889				
1890	oak, ash, alder, beech larch, elm larch, alder, ash, oak			
1891	larch, alder, birch larch, ash, beech			
1892	larch, beech, ash etc. larch, oak, etc. larch, alder, etc. larch, ash, oak			

Table 35 (contd).

Year	Type of produce	Name and location of wood (original spelling retained)	Area, acres	Value, £
1894	larch, oak, ash, beech " " " "	Dan y deri Wood, Merthyr Great Wood, St. Fagans Coedcae Wood, Rudry	34 14 14	565 342 200
1896	ash, oak, beech etc. larch, etc. coppice larch larch, ash larch + cogwood	Coedysquire Wood, Michaelstone Rudry Rudry Rudry near Caerphilly Coed Coesau Whips Craigshenkin	29 22 } 11 } 19 32 24 } 5½ }	380 520 320 420 540
1901				
1905	larch, spruce mixed wood pit + cogwood	Park y Van, Caerphilly Danyderi Woods, Merthyr Vale Danyderi Woods	36 22 13	685 265 235

However, particularly in the middle of the 19th century the demand for wood was so great that the prices reached at sales were very much above those expected by the woods staff and the agent of the estate. After one sale in 1853, which realized a total of £2,005, Thomas Goddard wrote:

In this time it is impossible to value anything. The sale price has far exceeded my views, so much so that I fear it has been sold almost too dear; however, the purchasers are the best judges ⁶²⁴

The largest of the wood sales, all over £100, between 1853 and 1905 are given in Table 35.

It should be remembered that in addition to these large sales, many small sales were also made each year, but the woods accounts were kept in such a way that it is not practicable to determine the annual income broken down by categories of produce, i.e. timber, pitwood and cordwood. There are some apparent discrepancies between the woods income recorded in Table 32 and the income from major sales shown in Tables 34 and 35. These are explained by overlapping accountancy years, i.e. sums being entered in the books one or two years after the actual felling had taken place. In general, 10% of an agreed purchase price was paid immediately and the balance later in one or two instalments.

Table 35 shows that larch, oak and mixed hardwoods formed the bulk of the commercial woods of the estate in the second half of the 19th century. Coppice and some coppice-with-standards provided for the constant demand for pitwood and cordwood. Larch was grown in pure plantations, but also in mixtures with various broadleaved species. Larch/broadleaved mixtures were more favoured in the later part of the

century, this being the general silvicultural fashion intended to help keep the larch healthy. Some of the older plantations on the Plymouth Estate, e.g. Waterhall and Halfurt, still (1978) exhibit this species mixture, e.g. larch/sycamore/ash, and larch/beech/sycamore/ash. The mixtures were apparently established by planting larch into felled hardwood coppice. Sweet chestnut was also a favoured species forming a large proportion of the mixed hardwoods in Maerdy Wood (Radyr), planted early in the present century.

The pitwood was sold off in cords, generally in small amounts of 1-10 cords, but occasionally in large amounts of over 100 or even over 200 cords each. In 1852-76, pitwood prices ranged from 12s. to 40s. per cord, depending on species, size and location. The tree species used for pitwood are rarely specified but certainly included oak and larch, and presumably mixed hardwoods.

Later in the century, cogwood appeared as a special assortment in the accounts. (Cogwood was small lengths of roundwood, up to ca. 6ft. long, used in mines for building up a crib-framework to be filled in with waste material and wedged at the top to support the roof).

The cordwood sales followed a pattern generally similar to the pitwood, i.e. many small sales and occasional very large sales. Prices in the period 1852-77 were 4s. to 9s. per cord (mostly 7s. to 9s.). Species are never stated but presumably the cordwood consisted of mixed hardwoods. The main sale of cordwood appears to have been for charcoal for smelting. Local iron works regularly bought cordwood from the Plymouth Estate. In 1831 the standard prices paid were:

7s.	per	Sh[or]t	Cord	if	within	5	miles	of	Pentyrch	Works
6s.	"	"	"		from	5	to	10	"	"
5s.	"	"	"		upwards	of	10		"	"

with a further deduction of 4d. per cord per mile for extra distance beyond 10 miles. Richard Blakemore wrote from Melingriffith Works on 9th June 1831 'at these prices we shall be happy to purchase any Cordwood the Earl of Plymouth may have for sale'.⁶²⁵

It is possible to reconstruct the yields of some individual woods from the accounts, e.g. Wernddu near Caerphilly, Coed y Gof near Saint Fagans, and Dan-y-Deri near Merthyr.

Table 36. Yields from Wernddu Wood, Caerphilly.

Year	Produce	Area, acres	Value £
1857	larch, pitwood + cordwood	30	700
1858	larch, pitwood + cordwood	45	1205
1859	pitwood + coppice, larch	30	1310
1860	larch etc.	ca. 12	ca. 400
1862	larch + coppice	15	135
1867	pitwood + cordwood	40	900
1869	larch, pitwood + cordwood	13	ca. 300
1875	unspecified	-	ca. 500 (?)
1892	larch, birch, alder, beech, ash	29 ³ / ₄	530
1892	larch, alder, birch, oak, beech & ash	22 ¹ / ₂	540

Table 37. Yields from Coed y Gof, St Fagans.

Year	Produce	Area, acres	Value £
1853	unspecified	17	ca. 300
1880	coppice	13	205
1892	larch, ash, oak	6	120
c.1920	32 acres fit for cutting, larch + pine to be thinned	32	-

Table 38. Yields from Dan-y-Deri, Merthyr

Year	Produce	Area, acres	Value £
1849	oak	-	162
1856	coppice	-	240
1859	larch	25	480
1860	timber	-	250
1875	unspecified	-	ca. 500 (?)
1894	larch, oak, ash, beech	34	565
1905	mixed wood, pitwood, cogwood	35	500

Records of bark sales from the Glamorgan portion of the Plymouth Estate are complete for each year from 1824 to 1871, with the exception of only three years, viz. 1827, 1861 and 1867 (see Table 39).

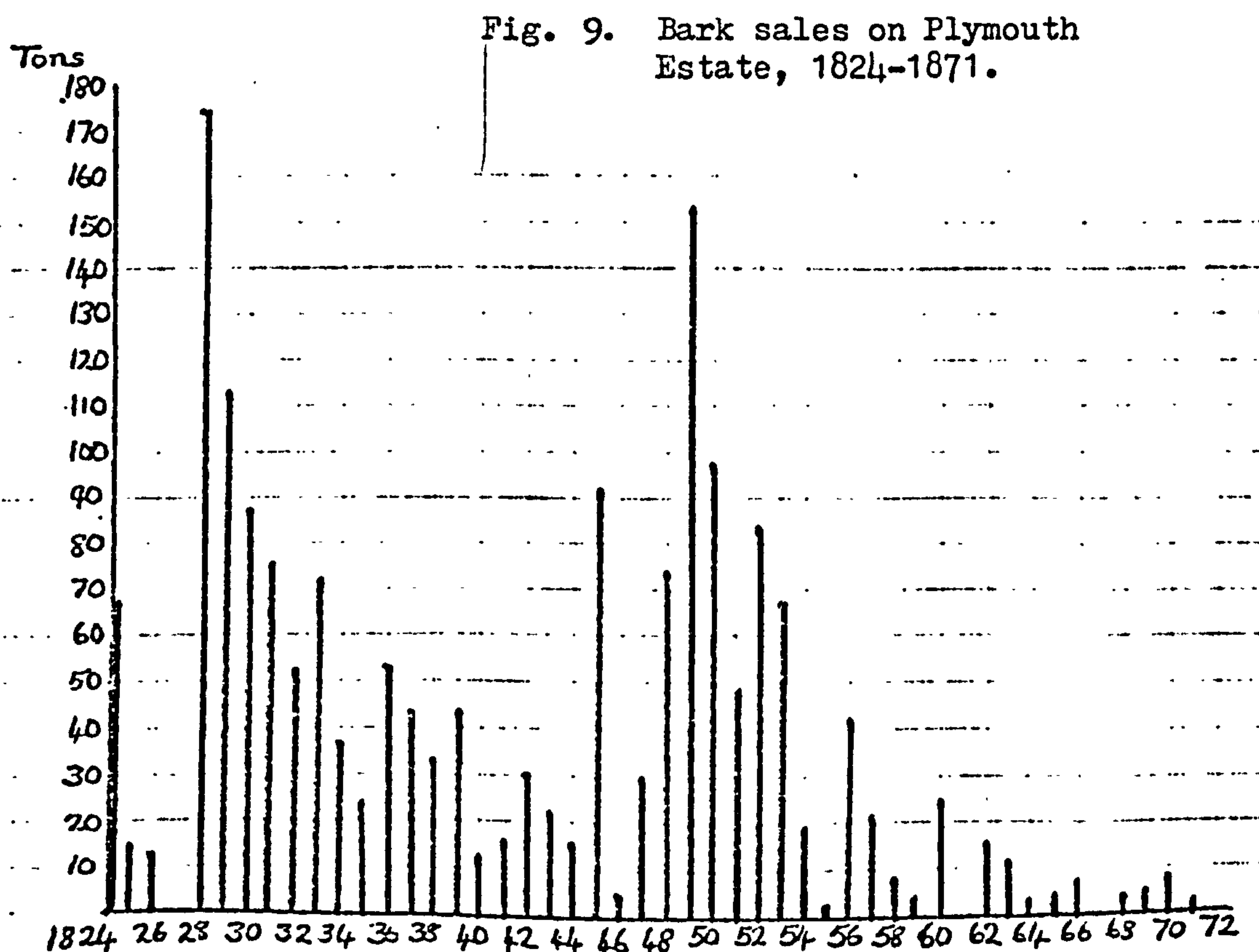
Table 39. Bark sales from the Plymouth Estate, 1824-1871.⁶²⁶

Year	Amount sold tons	Year	Amount sold tons
1824	68	1848	73
25	16	49	153
26	14	50	98
27	No record	51	49
28	173	52	83
29	112	53	67
30	87	54	19
31	76	55	2
32	51	56	41
33	71	57	21
34	37	58	8
35	23	59	4
36	52	60	24
37	43	61	No record
38	32	62	16
39	43	63	11
40	11	64	2
41	15	65	4
42	30	66	6
43	21	67	No record
44	15	68	3
45	92	69	4
46	4	70	8
47	30	71	2

Prices for the oak bark varied, depending on whether it was sold 'in the wood' or at Cardiff or Merthyr. Prices in the 1820s and 1830s were often over £7 per ton, e.g. in 1825 some bark was sold at £9 per ton 'delivered to Cardiff in good marketable condition'.⁶²⁷

Standard forms of agreement for sales of bark from the estate were used in the 1830s. These specified the parish(es) where the bark would be available in the current felling season, the agreed price per ton (the ton to be weighed as 21 cwt), and the condition of the bark, viz. 'to be delivered in good order and well-conditioned'. The bark was to be weighed by the hundredweight, and paid for on the 1st December following the sale. After the 1830s, bark prices generally declined to values of £4 or £5 per ton.

The bark sales from the Glamorgan portion of the Plymouth Estate are plotted in a histogram (see Fig. 9). The columns clearly illustrate two typical features viz. (i) the sharp fluctuations in production from year to year, characteristic of the oak bark harvest owing to its dependence on fellings for other purposes (cf. p.173); and (ii) the overall decline in demand for oak bark for tanning during the 19th century (cf. p.178).



The Glamorgan portion of the Plymouth Estate was located in an industrial area with a population that expanded dramatically during the 19th century. The pressures on the estate from trespass, poaching, theft and vandalism were considerable, despite the severity of the legislation in force designed to protect landed property. In 1821, posters were printed offering a reward of 10 guineas for information leading to the conviction of any person cutting down timber or young trees on the Plymouth Estate. The posters stated that:

great Depredations have been committed upon the Estates of the Right Honourable the Earl of Plymouth in the County of Glamorgan, by the Tenants and others, cutting down Timber and young Trees; they are therefore hereby desired to desist from such practices, and informed also that the above Reward of Ten Guineas will be paid, on Conviction, to any Person or Persons giving information, it being in future intended to enforce the penalties of the Law for the above Offence.

John Maughan, Agent. ⁶²⁸

Expenditure for printing and posting up notices warning against damage and trespass were regular items in the estate accounts during the 19th century, and the Plymouth Estate did prosecute transgressors. For example, in 1823 the estate accounts record an expenditure of 10s. incurred in the successful prosecution and conviction of one Edward Evans for stealing timber. ⁶²⁹

Accidental fire damage was also a problem, especially in the spring. For example, on 17 March 1893, sparks from a Taff Vale Railway engine caused a fire near Upper Boat, destroying about 8 acres of young larch, oak, ash, birch, etc.; a claim was duly made against the railway on 22 March for £80. Soon afterwards, on 30 March 1893, more serious damage occurred at the same place, 20-30 acres of 'fine young Larch from 6 to 16ft. high, also Oak, Ash, Birch etc.' being

burnt; again a claim was made against the railway company on 6 April for £300.⁶³⁰

One regular item of expenditure on the woods and plantations was for mole-catching. Moles were evidently regarded as serious pests, and their skins were of course valuable. In 1829, Thomas Price was paid £10 for making and setting 10 dozen mole pots* in the Caerphilly area.⁶³¹ Later on, regular payments of about £3 5s. per year were made to Thomas Price for mole-catching in the Caerphilly Woods and of about £2 5s. per year to Shadrack David for mole-catching at Saint Fagans.⁶³²

Towards the end of the 19th century, a fairly clear distinction was made between the commercial woods of the Plymouth Estate in the Caerphilly, Merthyr and Aberdare districts, and the amenity and sporting woods in the vicinity of the family seat at Saint Fagans.

In 1887 the farms of Llwynyreos and Tynewydd were acquired and converted into a park adjacent to the castle at Saint Fagans. The cost of labour and fencing came to ca. £4000, cheap labour being available as the local Pentyrch ironworks had closed. The park was laid down to grass, and 7 small plantations were established in it.⁶³³ The park later became the site for the Park Enclosure plantation scheme (see below, p.280 et seq.). H.A. Pettigrew was responsible for the woods and gardens at Saint Fagans, and from 1912 he was appointed woods manager or superintendent of all the commercial woodlands of the estate. Some

*Mole-pots are traps consisting of an earthenware jar or pot, buried below a tilting wooden trap-floor set in the mole run. The mole tips the trap-floor and falls down into the pot where it is either trapped or drowned. Wooden or metal 'pots' were sometimes used instead of earthenware pots.

of his surviving records give details of these amenity woods, and also shed some light on the policies adopted in the commercial woods as regards species choice etc.⁶³⁴

Larch had been the main commercial conifer on the estate throughout the 19th century. Scots pine had been tried repeatedly but, because of its poor performance, by the end of the century it had been abandoned as a commercial species, and relegated to the role of shelter tree on high and exposed sites. Scots pine was also favoured for ornamental planting. The disappointments with European larch (canker and die-back), especially in the commercial woods around Caerphilly, were attributed by Pettigrew primarily to the effects of air pollution. European larch was planted until the end of the 19th century, e.g. small larch plantations were established at Saint Fagans in mixture with Scots and Corsican pine in 1884, and also in the commercial woods in the outlying parts of the estate. However, small-scale trials were made with Japanese larch, e.g. in Plymouth Great Wood (near Saint Fagans), and thereafter Japanese larch was preferred to European larch for the commercial woods.⁶³⁵

The 1st Earl of Plymouth (1857-1923) took a keen interest in both the sporting and forestry side of the estate, and also in exotics and silvicultural experimentation. His plots of mixtures and exotics represented true pioneering forest experiments in Wales, and some still survive though neglected. In 1919 the Earl was awarded the Bronze Medal of the Royal Agricultural Society of England for Class 6 of the Plantations Competition, viz. 'Plantations of not less than 2 acres

consisting of Douglas Fir, Sitka Spruce, Japanese Larch, Corsican Pine, or any other rarer conifer, pure or mixed, of not less than five or more than thirty years' growth'. The prize-winning plantation was $10\frac{3}{4}$ acres of Sitka spruce at Ystrad Mynach, planted in 1911 as 2 + 2 plants, 4 ft. apart, in old coppice on a dry site at 450 ft. alt., annual rainfall 50 inches. At 8 years, the average height was 7 ft., with some trees up to 11 ft. high.⁶³⁶ In 1938 the Plymouth Estate was awarded the special silver gilt medal in the Royal Agricultural Society's show at Cardiff for the best collection of exhibits in the forestry section.⁶³⁷

The sporting interests of the estate tended to be concentrated in the neighbourhood of Saint Fagans. There was little game before 1878, but from that year (when Lord Windsor came of age) game was kept and carefully protected. A prolific rabbit-warren and pheasant-breeding preserves were maintained at Saint Fagans, and foxes were reared (5 or 6 litters were obtained in 1893). Tenants were forbidden to shoot, trap or destroy any game whatsoever, and any claims for game damage were referred to arbitration.⁶³⁸ The accounts of 1881 record expenditures totalling £189 18s. 1d. under a budget head entitled 'Watching to prevent trespass in woods and preserving game'. The items in this sum included food for game birds (pheasant meal, buckwheat, corn), partridge eggs, and dog-biscuits.⁶³⁹ The woods near Saint Fagans, e.g. Coed y Tranch, Rhydlafar, Coed y Gof, and Waterhall, were carefully managed for sport - the shooting rides were cut and cleaned regularly, at least up to

the 1920s. In the unenclosed plantations in Saint Fagans park, the cleaning and thinning operations were timed to avoid the nesting season of the game-birds.⁶⁴⁰

The 'Big Wood' (Coed Mawr or the Great Wood, 29 acres in 1766, enlarged later to some 50 acres), close to Saint Fagans, was a favoured recreation area for the Earl's family, though it too was worked commercially, e.g. larch, oak, ash and beech to the value of £342 was sold from 14 acres of the wood in 1894.⁶⁴¹ The encroachment of the Cardiff suburbs at the end of the 19th century meant that this wood was no longer a secluded place for the family's recreation, and the Earl had already determined upon an alternative, the Park Enclosure scheme, in 1908. During the First World War, all the mature timber in the Great Wood was bought by the Government, felled and removed. In 1922 the Earl gave most of the Great Wood (42 acres) to Cardiff Corporation as a public open space and recreation ground, and it was thereafter known as Plymouth Great Wood. The species present included beech, wild cherry, oak, holly, maple, scarlet oak, sweet chestnut, and some larch and Scots pine.⁶⁴²

The Saint Fagans Park Enclosure scheme was devised by the Earl of Plymouth to combine private recreation and his own interest in silviculture, especially in the performance of mixtures, exotics, and the effects of thinnings and stand density. In the words of Pettigrew, the woods manager, the Earl himself:

wished to decide by procedure on novel lines the relative merits of different methods of admixture ... Again the density requisite in the successful rearing of timber trees, and the effect of light and air on their subsequent development had always absorbed his interest and attention ... he realized the great importance and possibilities of discriminate thinning, a subject on which so great a diversity exists both among silvicultural theorists and practitioners alike. Here in the Park Enclosure he hoped to glean knowledge and enlightenment by treating groups of species to thinning operations governed solely by forethought and discreet considerations, and this unfettered and uninfluenced by the preaching of experts.⁶⁴³

The Park Enclosure was conceived as a fenced 78-acre triangle within Saint Fagans park. It lies partly on shale and thin limestone, and partly on red marl, at 100-140 ft. altitude. The enclosed land was part of open parkland, carrying only two small mixed conifer plantations (Scots pine, Corsican pine and European larch), and some much older line-plantings of oak. These were retained and an infrastructure pattern of open circles 50 yards in diameter connected by a quite complicated pattern of broad and narrow rides was laid out within the triangular enclosure (see Fig.10). In all, the triangle contained $1\frac{3}{4}$ miles of rides 30 ft. wide and $1\frac{1}{2}$ miles of rides 12 ft. wide. The rides divided the planting area into ten compartments and these compartments were further subdivided into lettered blocks or sections.⁶⁴⁴ All the

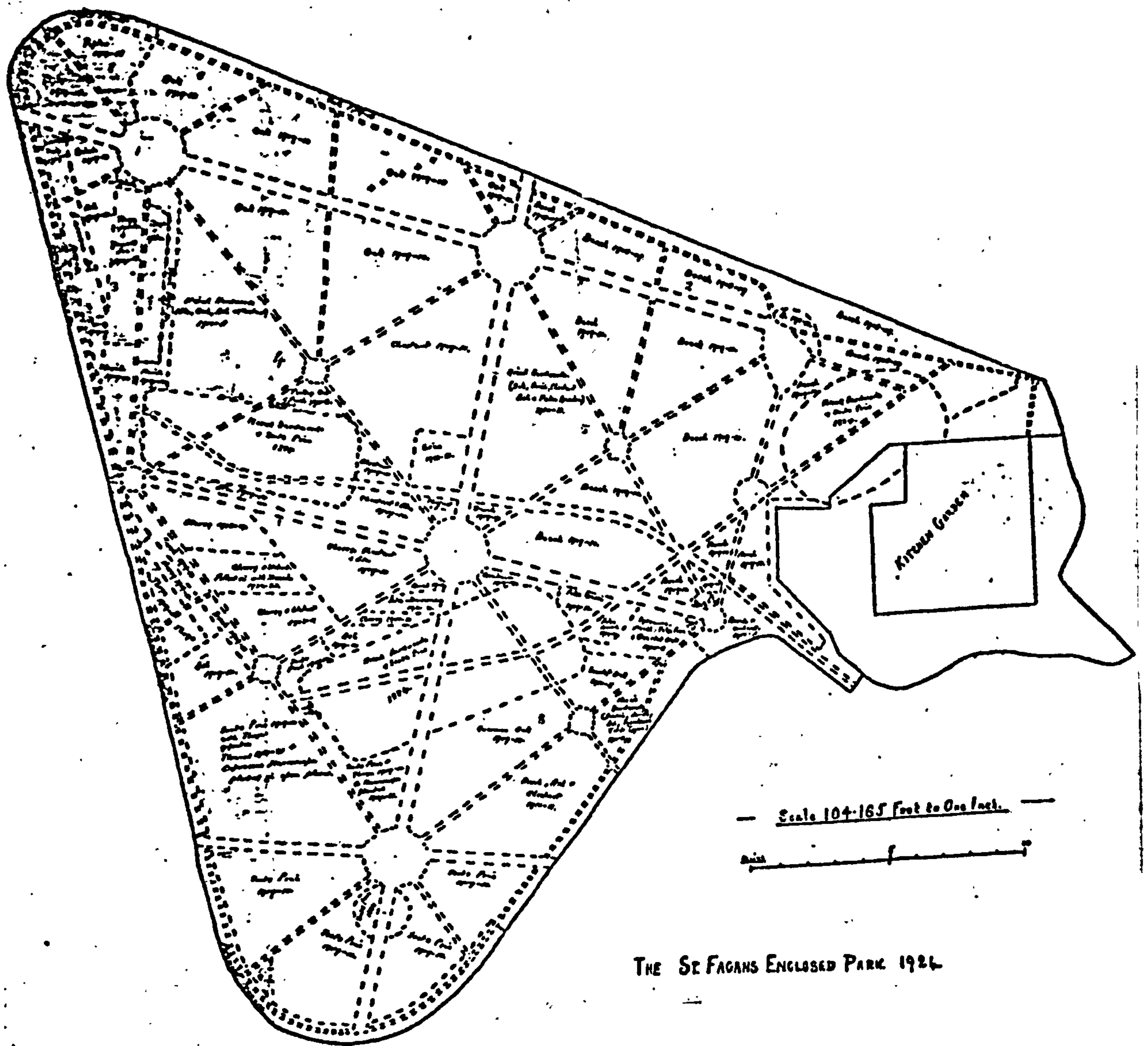


Fig. 10. The layout and planting scheme of the Park Enclosure, Saint Fagans.

land was double-ploughed and scuffled, and planted up by pit-planting mainly at square spacings of 4 x 4 or 3 x 3ft. during the 1908-9 and 1909-10 planting seasons. The planting gang was supervised by Pettigrew and by William Sampson Griffiths, who later left the Estate and established a flourishing nursery business at Bredon (near Tewkesbury).

The Earl of Plymouth's choice of species and mixtures was interesting. The full list of species planted is given in Table 40.

Table 40. Species planted in the Park Enclosure, Saint Fagans, 1908-1910 (Pettigrew's original nomenclature retained unchanged).⁶⁴⁵

Vernacular name	Scientific name
Alder	<i>Alnus glutinosa</i>
Ash, American	<i>Fraxinus americana</i>
Ash, Common	<i>Fraxinus excelsior</i>
Beech	<i>Fagus sylvatica</i>
Birch	<i>Betula verrucosa</i>
Cherry, American Black	<i>Prunus padus serotina</i>
Cherry, Gean	<i>Prunus avium</i>
Chestnut, Spanish	<i>Castanea sativa</i>
-	<i>Cupressus macrocarpa</i>
Elm, English	<i>Ulmus campestris</i>
Elm, Scotch	<i>Ulmus montana</i>
Hornbeam	<i>Carpinus betulus</i>
Lime	<i>Tilia vulgaris</i>
Oak, Common	<i>Quercus robur</i> var. <i>pedunculata</i>
Oak, Ilex	<i>Quercus ilex</i>
Oak, Scarlet	<i>Quercus coccinea</i>
Pine, Scots	<i>Pinus sylvestris</i>
Pine, Corsican	<i>Pinus laricio</i>
Pine, Austrian	<i>Pinus laricio</i> var. <i>nigricans</i>
Poplar, Black Italian	<i>Populus serotina</i>
Robinia	<i>Robinia pseudoacacia</i>
Sycamore	<i>Acer pseudoplatanus</i>
-	<i>Thuja plicata</i>
Tulip Tree	<i>Liriodendron tulipifera</i>
Walnut, Black	<i>Juglans nigra</i>
Willow, Cricket-bat	<i>Salix coerulea</i>

Of these 26 species, 8 are North American exotics. Most of the others are native or long-naturalized British species. None of the species planted was new to arboriculturists in Wales, but some of the species, especially the black walnut, robinia and tulip tree, had probably never been tried as forest trees in Wales before. Planting was done in pure stands, especially in the case of the major native hardwoods beech and oak, and also in various mixtures of two or more species, e.g. ash/robinia/oak/birch, or sycamore/ash/oak/Scots pine/Corsican pine. The Earl had a strong personal preference for Scots pine as an ornamental species, but he considered European larch 'an incongruity and blemish on our landscape', and expressly prohibited its planting within the Park Enclosure, though he was prepared to tolerate it in the commercial plantations on outlying parts of the estate.

Some of the planting stock used was produced in the estate's own home nursery, and the rest was bought from local firms or commercial nurseries further afield.

Details of the silvicultural treatment and management of the plantations, the performance of each species in pure stands or in the various mixtures, frost damage, growth rate, etc. were recorded by Pettigrew up to the 1930s.⁶⁴⁶ Unsuspected frost hollows proved a serious problem in the early years, the sweet-chestnut in particular suffering badly. Rabbits also caused depredations in the young plantations, destroying nearly all the tulip trees and damaging many other species.

Nurse trees such as birch were gradually removed from mixtures, and frequent light thinnings were made, the produce from the thinnings

going to provide pea-sticks, fencing posts, pit-props, firewood, cogwood, etc. Gaps were filled in with appropriate species, and considerable effort went into pruning, especially on the beech to eliminate multiple leaders. The expenditure on labour in the Park Enclosure was considerable: in 1923/4 the wages bill came to £218 8s.,⁶⁴⁷ and this after the woods staff had been obliged to accept a reduction in wages as from 1 June 1923. The wages of the 14 woods labourers were reduced to 6s. 8d. or 7s. per day.⁶⁴⁸

After about 1939 the Park Enclosure was left neglected and unthinned, and in 1947 it was donated to the National Museum of Wales as part of the site for the Welsh Folk Museum. Since 1950 parts of the plantations have been cleared, though some 40 acres still remain in 1978.⁶⁴⁹ None of the exotics has done particularly well; of all the species tried, the pure beech has done best.

Most of the lands in the Glamorgan portion of the Plymouth Estate, including most of the commercial woodlands, were disposed of during the 20th century. Some of the lands are now owned or leased by the Forestry Commission or private forestry enterprises. Only some farmland and a few small plantations in the vicinity of Saint Fagans have been retained as part of the Plymouth Estate.

3. Development Towards a State Forest Service

Since 1536 Wales had been treated for legislative purposes as part of England, and national forest policy, insofar as it existed at all, was concerned mainly with the Crown Forests, together with exhortations to landed gentry to plant and general legislation aimed at preserving or protecting woodland. Wales had remained unaffected by the major legislation promoting forestry in the great Crown Forests in England, e.g. the Acts for the increase and preservation of timber within the Forest of Dean (1668) and the New Forest (1698), and the combined Act for these two forests in 1808.⁶⁵⁰ Zukowski shows that the forest policy which had developed during the 'mercantilist' period from 1668 was discontinued in 1815 and replaced by a laissez-faire policy, especially with the formal adoption of Free Trade in 1846.⁶⁵¹ This had an adverse effect on forestry in England and Wales thereafter.

The General Surveys of agriculture carried out for the counties of Scotland, England and Wales in the 1790s and the early part of the 19th century gave an account of the woods of each county but did not attempt any statistical survey of woodland area. However, certain developments took place during the 19th century that made it possible to obtain statistics of all the woods and forests in the country, in addition to the Crown Forests. The first of these developments was the set of Tithe Surveys, carried out parish-by-parish in the

period ca. 1835-50. Although these surveys have been neglected by forest historians and have never been comprehensively collated, they are in fact the first attempt at a systematic national land-use survey since the Domesday survey of 1086, which in any case had covered very little of Wales (cf. p.53 et seq.). The Tithe Surveys therefore provide the first modern, fairly comprehensive and accurate set of statistics on land-use, and can be used to make the first good estimate of the area of woodlands in Wales. Although woodlands were normally exempt from tithes by prescription, they were generally recorded in the tithe apportionments. Two sample counties were selected, one (Glamorgan) representing a southern industrialized county, and the other (Merioneth) a northern rural county. All the available tithe apportionments made for each county were examined, viz. 127 in Glamorgan and 33 in Merioneth.* The area recorded as woodland for each parish was abstracted and totalled (see Tables 41 and 42). The Tithe Surveys give only the acreages of woodland in each parish. They contain no information on species, type of management, standing volume, or increment.

*The tithe apportionments examined are in GRO (Glamorgan Record Office, Cardiff) and NLW (National Library of Wales, Aberystwyth).

Table 41. Area recorded as woodland in each parish in Glamorgan in the Tithe Surveys.

Parish	Woodland (acres)	Parish	Woodland (acres)
Aberavon	-	Llanfabon	330
Aberdare	1,154	Llangan	-
Baglan	96	Llangeinor	-
Barry	78	Llangennith	-
Bettws	445	Llangiwg	300
Bishopston	171	Llangyfelach	1,000
Bonvilston	70	Llangynwyd	485
Cadoxton (Barry)	29	Llanharan	-
Cadoxton (Neath)	3,674	Llanharry	140
Caerau	32	Llanilid	60
Cardiff St. John	12	Llanishen	413
Cardiff St. Mary	-	Llanmadoc	-
Cheriton	15	Llanmaes	-
Cilybebyll	240	Llanmihangel	4
Coity Higher	101	Llanrhidian Upper	265
Coity Lower	26	Llanrhidian Lower	196
Colwinston	-	Llansamlet	100
Cowbridge	-	Llansannor	66
Coychurch (Pencoed)	109	Llantrisant	482
Coychurch Higher	162	Llantrithyd	32
Coychurch Lower	34	Llantwit j. Neath (Resolven)	2,000
Coychurch (Peterston s.M.)	109	Llantwit j. Neath (Upper)	188
Eglwysbrewis	-	Llantwit j. Neath (Lower)	527
Eglwysilan	1,536	Llantwit Fardre	324
Ewenny	-	Llantwit Major	-
Flemingston	6	Llanwonno	1,352
Gelligaer	1,043	Llysworney	-
Gileston	-	Loughor	-
Glyncorrwg (Blaengwrach)	265	Marcross	-
Glyncorrwg (Hamlet)	120	Merthyr Dyfan	60
Ilston	147	Merthyr Mawr	100
Knelston	-	Merthyr Tydfil	1,677
Laleston	-	Michaelston le Pit	224
Lavernock	-	Michaelston s. Avon	-
Lisvane	95	Michaelston s. Ely	-
Llanblethian	28	Monknash	-
Llancarfan	168	Neath	109
Llandaff	38	Newcastle	65
Llanddewi	-	Newton Nottage	30
Llandeilo Talybont	296	Nicholaston	82
Llandough (Cowbridge)	51	Oxwich	79
Llandough (Cogan + L.)	276	Oystermouth	282
Llandow	-	Penard	81
Llandyfodwg	615	Penarth	23
Llanedeyrn	150	Pendoylan	404

Table 41 (contd.)

Parish	Woodland (acres)	Parish	Woodland (acres)
Penlline	83	St. Donats	44
Penmaen	199	St. Fagans	99
Penmark	-	St. Georges s. Ely	40
Penrice	242	St. Hilary	95
Pentyrch	1,100	St. John (Swansea)	1
Peterston s. Ely	43	St. Lythans	95
Porteynon	-	St. Mary Church (Cowbridge)	28
Porthkerry	67	St. Mary Hill	45
Pyle & Kenfig	-	St. Nicholas	75
Radyr	198	Sully	14
Reynoldston	-	Swansea St. Mary	-
Rhossili	-	Tythegston	-
Roath	150	Welsh St. Donats	90
Rudry	400	Wenvoe	175
St. Andrews Major	300	Whitchurch	385
St. Athan	45	Ynysawdre	21
St. Brides Major	-	Ystradowen	95
St. Brides Minor	58	Ystradyfodwg	2,200
St. Brides s. Ely	12	Total	<u>29,290</u>

The recorded woodland area for Glamorgan is an underestimate

because:

- i) no apportionment was made for a few parishes, including the large parish of Margam which contained large areas of woodland;
- ii) no woodland at all was recorded in 33 parishes where apportionments were made, though some woods did exist; here, woods were presumably left unrecorded as being exempt from tithes;
- iii) some woods may be 'hidden' by being recorded as commons.

Accordingly, the true woodland area in Glamorgan would certainly be over 31,000 acres, and perhaps substantially greater.

Table 42. Area recorded as woodland in each parish in Merioneth in the Tithe Surveys.

Parish	Woodland (acres)	Parish	Woodland (acres)
Bettws G.G.	94	Llanfihangel y T.	529
Corwen	700	Llanfrothen	134
Dolgellau	1,871	Llangar	50
Ffestiniog	300	Llangelynin	99
Gwyddelwern	300	Llangower	400
Llanaber	315	Llansaintffraid G.D.	26
Llanbedr	300	Llanuwchllyn	200
Llandanwg	40	Llanvor	-
Llandderfel	700	Llanycil	100
Llanddwywe	130	Llanymawddwy	300
Llandrillo	-	Maentwrog	300
Llanegryn	150	Mallwyd	773
Llanelltyd	251	Pennal	1,193
Llanenddwyn	150	Talyllyn	1,228
Llanfachreth	-	Towyn	1,851
Llanfair	400	Trawsfynydd	-
Llanfihangel y P.	326	Total	13,210

The recorded woodland area for Merioneth is also an underestimate, perhaps substantially so, for the same reasons as given in (ii) and (iii) above for Glamorgan.

The results of these analyses for Glamorgan and Merioneth are summarized in Table 43, which shows the apparent percentage of woodland in the two counties.

Table 43. Woodland statistics from the Tithe Surveys for the counties of Glamorgan and Merioneth.

	Glamorgan	Merioneth
No. of parishes	127	33
Total woodland area, acres	29,290	13,210
Total area of county, acres	516,955	427,811
Woodland as %	5.7	3.1

The systematic collection of agricultural statistics by the government in England and Wales began only in 1866. The Board of Trade was entrusted with the task, but the actual work of data collection was carried out by the officers of Inland Revenue (Surveyors of Excise) from 1866 to 1918.⁶⁵² The making of returns was voluntary until 1917, and especially in the early years many landowners were reluctant to provide information, so that estimates had to be made.⁶⁵³ No woodland statistics were collected in the first returns (1866 and 1867), but woodlands were included for the first time in the 1871 returns. Table 44 collates the total acreages of woods and plantations for each of the counties of Wales from the returns made between 1871 and 1913.

Comparison of the underestimated figures of woodland area from the Tithe Surveys for Glamorgan and Merioneth (Table 43) with the Agricultural Returns for 1871 (Table 44) indicates an apparent considerable decrease in woodland area over the period. The decrease amounts to over 9000 acres in Glamorgan and 2500 acres in Merioneth. The decrease is probably illusory because the data in the earliest Agricultural Returns are seriously suspect as a result of the number of 'estimates'. The later returns (1887 onwards) are more accurate; these indicate an apparent decrease of over 5500 acres of woodland in Glamorgan and an apparent increase of ca. 1800 acres of woodland in Merioneth between the Tithe Survey and the 1887 return.

Table 44. Total acreages of woods and plantations, by counties, from the
Agricultural Returns.⁶⁵⁴

Counties	Years of the Returns						
	1871	1887	1888	1891	1895	1905	1913
Anglesey	1,198	1,769	1,693	1,853	2,193	2,422	2,409
Brecon	9,233	10,414	12,456	13,955	13,956	14,532	14,319
Caernarfon	6,746	10,938	11,015	11,654	12,593	11,716	15,978
Cardigan	11,257	14,738	15,650	15,758	15,989	16,341	18,437
Carmarthen	15,577	21,516	21,396	22,346	23,290	23,936	22,919
Denbigh	13,512	16,705	17,686	17,961	18,422	18,872	18,972
Flint	5,375	5,579	7,307	7,839	8,209	7,470	7,565
Glamorgan	19,864	23,687	23,195	25,694	27,206	25,712	25,830
Merioneth	10,635	15,049	15,771	13,750	14,407	15,912	15,270
Monmouth	28,484	29,856	32,037	33,415	32,733	32,149	29,839
Montgomery	18,775	22,744	22,090	23,728	24,730	25,776	23,866
Pembroke	5,930	10,064	9,116	9,776	9,698	10,105	10,330
Radnor	8,523	7,583	10,196	10,653	10,917	11,567	10,760
Wales total	155,109	190,642	199,608	208,382	214,343	216,510	216,494

Table 45 shows the woodland acreages of each county (from Table 44) as percentages of total land area.

Table 45. The percentage areas under woods and plantations in selected years, from the Agricultural Returns

	Total Area (acres)	Percentage of land under woods and plantations in				
		1871	1887	1891	1905	1913
Anglesey	175,836	0.68	1.00	1.05	1.37	1.37
Brecon	469,904	1.96	2.21	2.96	3.09	3.04
Caernarfon	360,137	1.87	3.03	3.23	3.25	4.43
Cardigan	443,186	2.54	3.32	3.55	3.68	4.16
Carmarthen	587,816	2.64	3.66	3.80	4.07	3.89
Denbigh	424,555	3.18	3.93	4.23	4.44	4.46
Flint	164,061	3.27	3.40	4.77	4.55	4.61
Glamorgan	516,955	3.84	4.58	4.97	4.97	4.99
Merioneth	427,811	2.48	3.51	3.21	3.71	3.56
Monmouth	349,119	8.15	8.55	9.57	9.20	8.54
Montgomery	510,111	3.68	4.45	4.65	5.05	4.67
Pembroke	392,595	1.51	2.56	2.48	2.57	2.63
Radnor	301,164	2.83	2.51	3.53	3.84	3.57
Wales total	5,123,250	3.02	3.72	4.06	4.22	4.22

* From A.W. Ashby and I.L. Evans. The Agriculture of Wales. 1944. p. 208

The figures in Tables 44 and 45 indicate an apparently substantial increase in the woodland area during the 1870s, but this is certainly because the 1871 data are serious underestimates. From the 1887 Return onwards, the figures show a fairly stable pattern, and towards the end of the 19th century the figures are probably quite accurate. Therefore, the extremely low woodland percentage area of 3.02% in 1871, which is often cited, did not correspond to the actual situation, and a woodland percentage area of ca. 4%, as indicated by the earlier Tithe Surveys and by the later Agricultural Returns, is probably closer to the truth. Even so, the forest area of Wales had been reduced from a maximum of about 90% of the land area to about 4% in the

space of a few thousand years. Within Wales, the percent woodland area varied quite considerably by counties, being little over 1% in Anglesey and about 9% in Monmouthshire. Most of the other counties had woodland areas of about 3-4%.

The earlier Agricultural Returns provided data only on woodland area by counties, but even these have been misquoted or misleadingly cited, even by authoritative sources. For example, the Forestry Commission's Census of Woodlands 1947-1949 cites the nominal total woodland of Wales in successive surveys from 1871 to 1947; however, the figures tabulated for the 1871, 1887 and 1895 surveys do not include the woodland acreage for Monmouthshire, whereas the figures tabulated for the surveys between 1905 and 1947 correctly include the woodland acreage for Monmouthshire.⁶⁵⁵

The earlier Agricultural Returns provided data only on woodland areas, but the later Agricultural Returns provided additional data on various other aspects of forestry in Wales, notably the area of forest nurseries (Table 46), the area of new plantations (Table 47), and the area of the major types of woods (Table 48). Even so, the only data collected in the Returns were acreages, and no attempt was made to collect statistical information on tree species representation, age-classes, standing volume, or increment.

The figures in Table 46 show quite considerable fluctuations in the area of forest nurseries within individual counties over a quite short time-span, 1887-1892. This would suggest that the nurseries themselves were often temporary or short-lived enterprises.

Table 46. Area of forest tree nurseries in Wales in 1887, 1891, and 1892, in acres.⁶⁵⁶

County	Area of nurseries in		
	1887	1891	1892
Anglesey	20	—	—
Brecon	13	8	7
Caernarfon	16	35	30
Cardigan	26	14	19
Carmarthen	46	45	34
Denbigh	29	23	24
Flint	7	2	8
Glamorgan	72	57	63
Merioneth	11	18	16
Monmouth	24	32	25
Montgomery	22	21	29
Pembroke	6	5	6
Radnor	9	2	4
Wales, total	301	230	240

Table 47. Areas of new plantations established in Wales in the periods 1881-91, 1881-95 and 1903-13.⁶⁵⁷

County	Acreages of new plantations in			
	1881-91	1881-95	1891-95*	1903-13
Anglesey	159	220	61	32
Brecon	1,212	1,540	328	948
Caernarfon	847	1,068	221	187
Cardigan	976	1,017	41	695
Carmarthen	1,720	2,099	379	1,546
Denbigh	528	1,111	583	421
Flint	179	202	23	164
Glamorgan	1,796	2,299	503	2,111
Merioneth	443	426	-17	371
Monmouth	1,043	984	-59	2,237
Montgomery	1,410	2,858	1448	1,195
Pembroke	218	306	88	277
Radnor	230	507	277	879
Wales total	10,761	14,637		11,063

* Figures obtained by subtracting acreages in column 1 from those in column 2. The negative figures for Merioneth and Monmouth indicate errors in the official acreage returns in either column 1 or column 2.

Table 47 shows that in the period 1881-1913 the rate of new planting in the whole of Wales was only approximately 1000 acres per annum. The Rating Act (1874) had made the land, and not the timber or underwood it carried, the subject of assessment. For valuation purposes, under the Act woodland was divided into three classes:

- A) Land used only for a plantation or a wood: the value is estimated as if the land, instead of being a plantation or wood, were let and occupied in its natural and unimproved state;
- B) Land used for the growth of saleable underwood: the value is estimated as if the land were let for that purpose;
- C) Land used both for a plantation or a wood and for the growth of saleable underwood: the value is estimated either as A or as B, as the assessment committee may determine.⁶⁵⁸

The rating of woodlands was generally thought to have deterred many landowners from planting, as indicated by witnesses giving evidence to various parliamentary committees and commissions, e.g. Evan Powell (land-agent and surveyor, of Llanidloes) to the Select Committee on Forestry (1887).⁶⁵⁹

Table 48 shows that just before the First World War the area recorded as coppice was just under 20% of the total woodland area in Wales, and the area of young plantations (under 10 years old) formed slightly over 5% of the total woodland area in Wales. The proportion of coppice differed considerably by counties, being below 10% in all the counties except for Glamorgan (17.9%), Radnor (23.7%), Carmarthen (23.9%), and Monmouth (71%). The

Table 48. Acreages of major types of woods, by counties, in 1913.⁶⁶⁰

County	Coppice, acres	Plantations (under 10 years old)	Other woods, acres	Total, acres
Anglesey	41	32	2,336	2,409
Brecon	849	948	12,522	14,319
Caernarfon	455	187	15,336	15,978
Cardigan	1,845	695	15,897	18,437
Carmarthen	5,473	1,546	15,900	22,919
Denbigh	480	421	18,071	18,972
Flint	139	164	7,262	7,565
Glamorgan	4,615	2,111	19,104	25,830
Merioneth	1,178	371	13,721	15,270
Monmouth	21,193	2,237	6,409	29,839
Montgomery	1,706	1,195	20,965	23,866
Pembroke	924	277	9,129	10,330
Radnor	2,550	879	7,331	10,760
Wales, total	41,448	11,063	163,983	216,494

very high proportion of coppice in Monmouthshire is striking, and this one county in fact accounted for over half of all the recorded coppice in Wales. It is possible, however, that differences of definition of coppice and coppice-with-standards may account for some of considerable differences between counties as regards the proportion of coppice woods.

The 1901 Census Returns give the number of foresters and woodmen employed in Wales (Table 49). These figures presumably refer to persons in full-time employment in forestry, and take no account of casual labour employed for seasonal jobs such as the bark harvest.

The total number of workers classed as foresters and woodmen (all male) in Wales in 1901 was just under 1000, and this represented just under 1% of the total agricultural labour force. Of the total number of males employed in agricultural occupations (91,668 men), foresters and woodmen represented 1.06%.

Table 49. Agricultural occupations from the 1901 census returns.⁶⁶¹

County	Total males & females	No. of foresters & woodmen	Foresters & woodmen as % of total
Anglesey	6,877	14	0.20
Brecon	5,291	64	1.20
Caernarfon	8,303	66	0.79
Cardigan	8,725	29	0.33
Carmarthen	13,543	75	0.55
Denbigh	10,490	99	0.94
Flint	5,165	46	0.89
Glamorgan	9,782	139	1.42
Merioneth	5,135	39	0.75
Monmouth	7,914	271	3.42
Montgomery	9,118	73	0.80
Pembroke	9,457	33	0.34
Radnor	4,227	30	0.70
Wales, total	104,027	978	0.94

From the data of the Agricultural Returns and the Census Returns (Tables 44 and 49) it is possible to derive an estimate of the intensity of forest management in the various counties of Wales at the beginning of the present century. This is obtained by dividing the area of woods and plantations in 1905 by the number of foresters/woodmen in 1901, to give the average woodland acreage per forester/woodman (Table 50).

Table 50. Forest management intensity (woodland acreage per forester) in Wales.

County	No. of foresters & woodmen (1901)	Area of woods & plantations, acres (1905)	Average woodland area, in acres per forester
Anglesey	14	2,422	173
Brecon	64	14,532	227
Caernarfon	66	11,716	177
Cardigan	29	16,341	563
Carmarthen	75	23,936	319
Denbigh	99	18,872	190
Flint	46	7,470	162
Glamorgan	139	25,712	184
Merioneth	39	15,912	408
Monmouth	271	32,149	118
Montgomery	73	25,776	353
Pembroke	33	10,105	306
Radnor	30	11,567	385
Wales, total	978	216,510	221

Monmouthshire, the county with the greatest area of woodland, the greatest percentage area of woodland and the greatest proportion of coppice, was clearly the most intensively managed county (118 acres/forester), and Cardigan-shire by far the least intensively managed (563 acres/forester).

During the 19th century the increasing sense of professionalism in forestry resulted in the formation of societies devoted to the furtherance of forestry in Britain, viz. the Scottish Arboricultural Society (founded in 1854), the English Arboricultural Society (1881)*, and the Irish Forestry Society (1901). Despite their original names, these Scottish and English societies were concerned from the start with forestry proper as well as with arboriculture. No professional forestry society was ever formed in Wales, though many Welsh landowners and their foresters (usually expatriate Scots) were members of the Scottish and/or English societies. The journals of these societies, and many books written by individuals, prominent among whom was J. Croumbie Brown, provided a medium for expressing the growing need for an appropriate forest policy, including: (1) professional forestry education for the requirements of Britain and the Empire; (2) Government support for private forestry in the form of loans or grants; (3) research and experimentation in forestry; (4) a large-scale state afforestation scheme; and (5) the formation of a state forest service on the pattern of services in countries such as France and Germany.

*The English Arboricultural Society eventually became the Royal English Arboricultural Society and in 1931 changed its name to the Royal English Forestry Society, but it was not until after 1947 that it became officially the Royal Forestry Society of England and Wales.

As a result of this pressure, a certain amount of government activity took place towards the end of the 19th century. A Select Committee of the House of Commons was set up in 1885 to consider 'whether, by the establishment of a Forest School, or otherwise, our woodlands could be rendered more remunerative'. The Select Committee reported, in 1887, on the desirability of establishing forest schools in England and Scotland and also in Ireland, and on the economic and social benefits of extensive planting schemes in many parts of the kingdom. Evan Powell, land-agent and surveyor of Llanidloes, gave evidence to the Committee that 'there is probably a larger area of unplanted land in Wales that would pay for planting than in any other portion of the kingdom'.⁶⁶²

In 1889 another Select Committee was appointed to inquire into the administration of the Department of Woods and Land Revenues of the Crown. Under the Board of Agriculture Act (1889) the Board was empowered to undertake various measures for assisting and promoting forestry.⁶⁶³

The particular problems of land in Wales were recognized in the report of the Royal Commission on Land in Wales & Monmouthshire (1896). In evidence to this commission J. Muir, the forester of the Margam estate (Glamorgan), proposed a scheme for State aid to assist landowners to plant by lending at a low rate of interest the capital necessary to plant and enclose the land and also an amount of money sufficient to recoup the rent lost during the early unproductive years of the plantation (cf. p.243).⁶⁶⁴

In 1902, a Departmental Committee was appointed 'to inquire into and report as to the present position and future prospects of forestry, and the planting and management of woodlands in Great Britain, and to consider whether any measures might with advantage be taken ... for their promotion and encouragement'. The recommendations of this Committee are summarized in extenso by Nisbet.⁶⁶⁵ One of the practical outcomes of the Committee's recommendations was the award of a grant of £250 per annum by the Board of Agriculture and Fisheries for the establishment of a lectureship in forestry at the University College of North Wales at Bangor. This led in 1904 to the formation of a School of Forestry, and the appointment of Fraser Story as lecturer in forestry at the University College. In 1912 the School was further strengthened by the appointment of T. Thomson as lecturer in forestry and assistant to Professor Story, then head of the department.⁶⁶⁶

At the very end of the 19th century the Crown purchased one substantial area of land for planting and another substantial area of established woods in Wales, viz. Hafod Fawr (Merioneth) and much of Tintern Forest (Monmouthshire).⁶⁶⁷ Hafod Fawr, consisting of 1369 acres of hill sheep land, was bought in 1899, and a resident woodman was put in charge soon after; 210 acres were enclosed and planted by 1915, mainly with Scots pine but also with Japanese larch and Sitka spruce. Nearly 4000 acres at Tintern, mainly carrying coppice with standards, were bought from the Duke of Beaufort in 1901. These Crown woods at Hafod Fawr and at Tintern were subsequently transferred

to the Forestry Commission under the Forestry (Transfer of Woods) Act of 1923. The Hafod Fawr pioneer scheme proved valuable in species selection for exposed peatland sites, and it also focussed attention on the importance of the sheep problem. Details of the Hafod Fawr scheme, viz. the costs of land acquisition, the problems of tenant farmers, and the expense of labour, pit-planting of large planting stock, and fencing against mountain sheep, were described by E. Stafford Howard (one of the Commissioners of Crown Woods, Forests and Land Revenues) in evidence to another government committee.⁶⁶⁸

In addition to the Hafod Fawr experiment, another important experimental scheme of species trial plots was started in North Wales early in the 20th century. This was the Chirk forestry experimental area of the Denbighshire County Council. It was an upland area of 50 acres at 900-1200 ft., donated to the Council by John Mahler of Penisa'r Glyn (near Chirk), and planted up as species trial plots under the direction of the Forestry Department of the University College, Bangor.⁶⁶⁹

Other large-scale corporate afforestation schemes in Wales in the late 19th century and early 20th century were those carried out by various English Water Boards around their reservoirs built in Welsh catchments, notably around Lake Vyrnwy (Liverpool Corporation) and the Elan Valley reservoirs (Birmingham Corporation). For example, at Lake Vyrnwy in 1893 the catchment contained 172 acres of old native hardwoods (mainly oak), 25 acres of old plantations (mainly larch) and 273 acres of new plantations (mainly larch, but also spruce

and several species of pine⁶⁷⁰). In the Elan Valley catchment, over 1000 acres were planted before 1918, mainly with Scots pine and European larch, but also Japanese larch, Douglas fir, Sitka spruce and Corsican pine. One plantation of pure European larch, with Scots pine for shelter at the higher elevations, planted 1904-5, was awarded the Silver Medal at the Royal Agricultural Society's show in 1919.⁶⁷¹

Lloyd George, as Chancellor of the Exchequer, in introducing his 1909 Budget ('the People's Budget'), referred at length to the question of afforestation: 'there is very general agreement that some steps should be taken in the direction ... of reafforesting the waste lands of this country', but he concluded:

there is a good deal of preliminary work which ought to be undertaken in this country before the Government could safely begin planting on the large scale ... to rush into planting on a huge scale without first of all making the necessary experiments, organizing a trained body of foresters and taking all other essential steps to secure success when you advance, would be to court disaster, which might discourage all future attempts.⁶⁷²

Despite the growing climate of opinion for major state involvement in forestry, no definite measures were taken until the pressure of the First World War forced rapid action. In 1914, over 90% of Britain's wood supplies came in the form of imports, and per capita wood consumption had recently risen quite considerably. The critical timber supply position was not fully realized until 1916, when a Timber Supplies Department

was hastily created; also, a Women's Forestry Corps was formed, and overseas units such as a Canadian Forestry Corps came into operation to accelerate the felling and utilization of home timber supplies.⁶⁷³ A whole series of orders was issued by the Controller of Timber Supplies and by the Board of Trade governing the sale and prices of timber, viz. The Home Grown Timber Prices (Great Britain) Order, 1917 (T. 24051) (4 July 1917) which fixed maximum prices for timber of the ordinary qualities, and The Standing Timber (United Kingdom) Order, 1917 (T. 18464) which prohibited the sale of standing timber without the licence of the Controller; these were quickly replaced or complemented by other orders, e.g. The Home Grown Timber Prices Order 1917 (4 Dec. 1917), The Home Grown Timber Prices Order 1918 (T. 24,734), The Timber Control Order 1918 (No. 887) (16 July 1918), The Pitwood Order 1918 (29 July 1918), and The Fuel Wood Order 1918 (27 Sept. 1918).⁶⁷⁴

In July 1916 the Prime Minister appointed the Forestry Sub-Committee of the Ministry of Reconstruction 'to consider and report upon the best means of conserving and developing the woodland and forestry resources of the United Kingdom, having regard to the experience gained during the war'. In 1917 this sub-committee, commonly called the Acland Committee (after its chairman, the Rt. Honourable F.D. Acland M.P.) recommended the adoption of an adequate forest policy, including a large long-term state afforestation programme and the creation

of an appropriate state forest service. In its report, the committee commented, with reference to the conifer afforestation of waste land in France in the 19th century:

'If our statesmen, even thirty years ago, had shown equal foresight, most of the timber required [for maintenance of naval coal supplies] could have been grown on the Welsh hills' ⁶⁷⁵

The Acland Committee recommended one central forest authority for Britain, with separate consultative committees for England, Wales, Scotland, and Ireland. Authoritative voices had for some time urged the formation of an autonomous Welsh Forestry Board, e.g. W. Craven Llewelyn (of the Forestry Supplies Department), and W.R. Fisher, chief editor of the Quarterly Journal of Forestry (the official journal of the Royal English Arboricultural Society). ⁶⁷⁶

In due course, after the Acland Committee's report had been submitted and debated, a forestry bill was drafted and passed rapidly through its various stages: it was introduced into the House of Lords on 7 July 1919 and received the Royal Assent on 19 August 1919. Under the provisions of the Forestry Act of 1919, establishing the Forestry Commission, Wales was not accorded equal status with Scotland and Ireland: three Assistant Commissioners were appointed, one (Hugh Murray) responsible for England and Wales, one for Scotland, and one for Ireland. ⁶⁷⁷ The work in Wales under the Assistant Commissioner was carried on by two Divisional

Officers responsible respectively for North Wales (D.W. Young, from Shrewsbury) and South Wales (W.H. Lovegrove, from Hereford). Consultative committees were provided for each of the four countries; the committee for Wales consisted of the following:

Chairman:- The Rt. Hon. the Lord Kenyon, K.C.V.O.
 Vice-Chairman:- Col. F.D.W. Drummond, C.B.E., D.L.

G.B. Bovill, Esq.
 Alderman T.W. David, J.P.
 Lt.-Col. J.R. Davidson, C.M.G.
 Major David Davies, M.P.
 Capt. J.D.D. Evans
 Col. W. Forrest, D.S.O., D.L., J.P.
 Vernon Hartshorn, Esq., M.P.
 G.A. Humphreys, Esq.
 C. Bryner Jones, Esq., C.B.E., M.Sc.
 John Jones, Esq.
 Lt.-Col. W.N. Jones, J.P.
 Col. Chas. Venables Llewellyn
 F.J. Matthews, Esq.
 The Rt. Hon. the Earl of Powis, D.L., J.P.
 L.R. Pym, Esq.
 D.C. Roberts, Esq.
 J. Roberts, Esq.
 Major-Gen. A.E. Sandbach, C.B., D.S.O.
 J.I. Storrar, Esq.
 The Rt. Hon. the Lord Tredegar
 H.C. Vincent, Esq.
 Percy Wilkinson, Esq.
 Col. Sir H.L. Watkin Williams-Wynn, Bart., C.B.
 Secretary:- H.A. Pritchard, Esq., O.B.E.⁶⁷⁸

This then was the embryo executive organization and consultative body responsible for ushering in the new era of State forestry involvement in Wales alongside the existing private forestry interests.

The formation of the Forestry Commission in 1919 marked a major watershed in the history of forestry in Wales. The course of forest policy, technical developments in forestry and the sociological implications of forestry in Wales subsequent to the formation of the Forestry Commission do not form part of this study. The development of forestry in Wales since 1919 can be traced to a large extent from easily accessible published sources, notably the official publications of the Forestry Commission itself, such as the Annual Reports, the Census of Woodlands reports, the various guides to individual forests and parks*, and also from the more personal contributions by serving or retired staff, e.g. Forest Service (by G. Ryle) and Gwydyr Forest in Snowdonia : a History and Tales from the Gwydyr Woods (both by D.L. Shaw).

It is, however, appropriate to try to review briefly the condition of forestry in Wales at this historic watershed (1919), i.e. to assess in broad general terms the circumstances, both ecological and sociological, of prime significance to forestry at the end of the long period of history covered in this study.

The most obvious and fundamental fact had been the reduction of the forest area of Wales from a maximum of some 90% of the land area to between 4 and 5%. This long process

* e.g. Glamorgan Forests, Cambrian Forests, Rheola Forest, Coed y Brenin, Snowdonia Forest Park, and Dean Forest and Wye Valley.

of decline in forest area had also occurred in the other countries of northern and western Europe, but nowhere was it more pronounced than in the British Isles, and especially in Ireland and Wales. The process of decline in forest area culminated in the large-scale felling of broadleaved and coniferous woods during the First World War, which was relatively much more severe in Wales than in England or Scotland. The result was a very large increase in the proportion of the area classified as unproductive (scrub, felled and devastated). The 1924 Census of Woodlands recorded 97,116 acres in Wales as scrub, felled or devastated; 24.5% of all Welsh woodland was classed as 'felled or devastated' (as against only 11.9% in England and 20.6% in Scotland), and 13.8% as 'scrub' (as against 5.4% in England and 19.4% in Scotland). In Pembrokeshire the felled area was 43.8% and in Cardiganshire over 50% of the woodland area of the county. Only Monmouthshire, traditionally subject to strong English influence, formed something of an exception to this general picture. This county, the stronghold of natural beech in Wales, had over the centuries retained a woodland percentage area practically double that of any other Welsh county and, with its high proportion of coppice woods, had by far the largest number of people employed in forestry (cf. p. 299). After the First World War, in Monmouthshire only 10% of the woodland area was classed as 'felled or devastated' and 7.7% as 'scrub'.⁶⁷⁹

In the space of a few millennia the natural vegetation of the whole country of Wales had been radically altered,

mainly as a result of deliberate human activity in the form of assarting and sheep-ranching. From the 16th century the development of metallurgical industry in Wales had an effect on forest management for charcoal (here there are parallels with contemporaneous activity in Central Europe, e.g. Germany and Slovakia)⁶⁸⁰, though the significance of charcoal-burning as being responsible for the large-scale disappearance of forests has been exaggerated by historians. However, from the 16th century onwards, woods had never covered more than 10% of the area of Wales as a whole, and only in a few individual areas, e.g. remote valleys, was there as much as 20% forest cover. Throughout historic times until two centuries ago the natural woodlands of Wales had been exclusively broadleaved, with only a few major forest types (cf. pp. 26-7), and with a relatively small number of tree species represented (yew being the only native coniferous tree). Familiarity with broadleaved species but ignorance of conifers had long been manifest in Welsh life and culture.

At the time of the Edwardian Conquest, the Welsh were still primarily a woodland people, living to a large extent in or in close proximity to broadleaved woodlands. Indeed, the first 'forest policy' for Wales was one imposed by conquerors and amounted to wholesale permanent clearance of woodland (cf. p. 59). Even so, in Medieval times, the common people could still fairly claim that 'the greater part of their sustenance is derived from the woods' (cf. p. 86), and the first recorded forestry experiment in Wales took place in 1351 (cf. p. 92). Multiple-use of forests and woods, a principle recently rediscovered by the forestry profession,

was an integral part of the normal way of life in the Middle Ages, though the system then was entirely dependent on natural regeneration. Wales' most famous poet, Dafydd ap Gwilym (fl. 1340-70) was a true forest poet, gaining his poetic inspiration in a woodland environment and using woodland motifs and images.⁶⁸¹ In the Middle Ages in Wales, the forests were vital resources but they were also places of mystery and magic. Since late Medieval times Wales had for the most part lost the traditional folk knowledge of woodlands, and the widespread awareness and understanding of the importance of woods that must formerly have existed. The significance of woods in poem, tale and tradition had virtually vanished.

The change in land-use that occurred in most of upland Wales, especially over the last millennium, largely replaced native trees by sheep-walks and rough grazing for cattle in the hafod and hendre system of transhumance. After the great enclosure movement of the 18th century, the system of transhumance disintegrated, and for two centuries 'traditional' upland sheep farming was practised.⁶⁸² Soil deterioration was both extensive and severe. With the loss of substantial areas of woodland went not only a way of life but also the main woodland animals - first the predators and later the herbivorous game animals, especially deer (cf. p. 136). In many treeless upland areas such as Epynt and Mynydd Hiraethog, the only wood locally available was sub-fossil material dug out of peat-beds. Even at lower altitudes, woodland clearance and degeneration were extensive. Surviving woodlands were fragmented and generally small, and consisted mainly of oak

and other hardwoods (often coppice oak), usually on hillsides too steep for arable agriculture. In the west of Wales, much of the oak was little better than scrub. So great was the effect of man that very few areas of natural or quasi-natural woodland can now be identified with any certainty in Wales (cf. pp. 15-16), but the evidence of former woods is present in the pollen record and in place-names. The flora of woods regularly cut over or coppiced is modified significantly - in Wales coppice oakwoods have only 16-40 species of epiphytic lichens per km², as against over 100 in the old relatively undisturbed forests.⁶⁸³ Modern conservation measures are aimed at identifying and safeguarding remnants of natural woodland zones still existing in Wales, e.g. sessile oak/birch in the southern coalfield, ash and ash/pedunculate oak/field maple in the Vale of Glamorgan, and beech/ash on the carboniferous limestone in south-east Wales.⁶⁸⁴

The surviving woodland remnants continued for a long time to provide a resource and livelihood for a quite substantial number of traditional full-time or seasonal woodland workers or rural craftsmen - turners, coopers, cloggers, hoopers, woodcutters, wheelwrights, boat- and ship-builders, itinerant pit-sawyers, muleteers, hurdle-makers, waggoners, faggot-makers, carpenters, cartwrights, pig-pannagers, fuelwood-gatherers, fellers, corders, charcoal-burners, bark-strippers and bark-choppers. These people practised their skills and activities in the woods or in small workshops near to their source of raw materials, but their numbers dwindled virtually to vanishing

point during the course of the 19th century under the pressure of economic and technological forces for change. With rural depopulation and an increasingly urbanized industrial population, only a faint folk memory and vestigial fragments now remain of the activity of these woodland craftsmen and workers. Though these traditional workers have virtually disappeared, employment in forestry in Wales has increased: from 978 in 1901 (see Table 49) to 1640 in full-time employment plus a further 550-1150 in seasonal or occasional employment in 1924.⁶⁸⁵ This may be compared with an estimated 4500 employed in forestry and related industries in Wales in 1972.⁶⁸⁶

When plantation forestry started in Wales in the 18th century, it paralleled similar activity in Scotland and England, and also in other countries such as Holland and Denmark, but in Wales it was not an indigenous growth. It was to all intents and purposes exclusively a feature of the large estates, often owned by absentee landlords and/or by landlords not of Welsh origin. Almost invariably the senior staff on these estates, including the foresters, were alien - mainly Scots (cf. pp. 224-5). These Scots were the men responsible for estate management, the protection of private property and game (grouse moors, fishing rivers, game coverts, breeding of foxes for hunting), and for plantation forestry. Following the fashion of large estates in Scotland, they introduced conifers, mainly Scots pine and European larch. Though exotic conifers had been introduced into Wales as early as the 1580s (cf. p. 132) it was not until the late 18th and the 19th century that planting of conifers started to bring about a

major alteration in the landscape of Wales. By 1924 this process had gone so far that the total area of coniferous high forest exceeded that of hardwoods. Analysis of the age-class distribution of high forest in the 1924 Census shows that 31.9% of all high forest in Wales was between 1 and 20 years old; of these 36,105 acres of high forest in age-class 1-20 years, no fewer than 31,873 acres (= over 88%) were pure conifers. Indeed, 41.5% of all the high forest in Wales in 1924 was coniferous, as against only 25.9% in England. Clearly the trend to planting mainly pure conifers in Wales was well established by private planters, long before the formation of the Forestry Commission. Subsequently this trend has, of course, continued and intensified, but although the economic and aesthetic advantages of conifers were realized by percipient observers over two centuries ago (cf. p. 193), much of public opinion in Wales today still remains at best unconvinced or even openly antagonistic. Functional blocks and strips of pine and larch were established for economic reasons, with little or no regard for aesthetic considerations; larch was favoured because it grew well on scrub oak sites, producing good pitwood and also good pheasant cover when mixed with a few Scots pine. In contrast, the demesne lands of many estates were carefully cultivated and developed, often with great skill and at great expense, so as to create varied and harmonious park-type landscapes of considerable aesthetic appeal in which individual trees and groups of trees figured prominently. These landscapes are an enduring heritage, many of which are still maintained by private individuals and various public authorities. Later on, exotic conifers, especially

from North America, were increasingly planted as commercial species and also as ornamental trees, many of which are still characteristic features in the Welsh landscape, e.g. pairs of sequoias planted before country houses, or individual araucarias on exposed eminences. At a humbler and more practical level, sycamores planted for shelter on upland farmsteads often still stand as evidence of the location of homes that have themselves long since disappeared.

Farm forestry in Wales amounted to little more than hedgerow management and the occasional shelterbelt. There are in Wales occasional examples of common woods that have been used for centuries by local farmers for a supply of coppice rods and poles, winter grazing, and mast for fattening pigs; some of these oak woods persist in an equilibrium without any conscious effort at management.⁶⁸⁷ Farmers who established plantations on their own land were rare indeed, and tenant farmers, deprived of financial interest in trees or woods on their land, developed an outlook generally hostile to forestry. Interest in woods and planting of conifers by small farmers as at Penrhiw (Llansawel, Carmarthenshire) was very much an exception to usual behaviour and attitudes.⁶⁸⁸ In general, Welsh agriculture was typified by a deep-rooted peasant conservatism, suspicion of new and alien ideas; rural poverty manifested by subsistence farming with no capital for investment; and a lack of technical and scientific education.

These then were the main historical factors and circumstances that conspired to alter a landscape and a people's attitude - to alienate Welsh people in general, in both rural and industrial areas, from forestry. The profound transformation that had taken place in the space of a few centuries in the woodland vegetation, in the pattern of life, and in the way of thinking in Wales can be starkly illustrated by brief extracts from two Welsh poems. The first is part of a strongly worded lament by an unknown local poet at the felling of woods in Glamorgan by English iron-masters during the 16th century (cf. p. 152):

Coed Glyn Cynon

Aberdâr, Llanwnno i gyd,
plwy Merthyr hyd Lanfabon;
mwy a adfyd a fu erioed
pan dorred Coed Glyn Cynon.

[Aberdare, Llanwynno through, —
all Merthyr to Lanfabon;
there was never a more disastrous thing
than the cutting of Glyn Cynon.]

Torri llawer parlwr pur,
lle cyrchfa gwŷr a meibion;
yn oes dyddiau seren syw
mor arael yw Glyn Cynon.

[They cut down many a parlour pure
where youth and manhood meet;
in those days of the regular star
Glyn Cynon's woods were sweet.]

Llawer bedwen glas ei chlog
 (ynghrog y byddo'r Saeson!)
 sydd yn danllwyth mawr o dân
 gan wŷr yr haearn duon

[Many a birch-tree green of cloak
 (I'd like to choke the Saxon!)
 is now a flaming heap of fire
 where iron-workers blacken.]

To the poet the felling of that forest was a violent and undesirable disturbance of the natural equilibrium of his environment. In the same way and for a precisely identical reason, in the 20th century another Welsh poet lamented the planting of trees on bare Welsh hillsides by the Forestry Commission, regarded as an alien (London-based) authority:

Ac erbyn hyn nid oes yno ond coed
 A'u gwreiddiau haerllug yn sugno'r hen bridd:
 Coed lle bu cymdogaeth
 Fforest lle bu ffermydd

[And by now there is nothing there but trees
 Their impudent roots sucking the old soil:
 Trees where there was neighbourliness
 Forest where there were farms]

Between these poles of emotion, it is hoped that this thesis forms a factual and balanced history of forests and forestry in Wales - an interpretation of the past as a basis for understanding the present and planning the future of Welsh forestry.

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The following abbreviations are used in the references:

BBCS	Bulletin of the Board of Celtic Studies
Cal.	Calendar
CFI	Commonwealth Forestry Institute, Oxford.
ClRO	Clwyd Record Office, Mold
CPL	Cardiff Public Library
CRO	Dyfed (Carmarthen) Record Office, Carmarthen
CUP	Cambridge University Press
GRO	Glamorgan Record Office, Cardiff
GwRO	Gwent Record Office, Cwmbran
NLW	National Library of Wales, Aberystwyth
NMW	National Museum of Wales, Cardiff
OUP	Oxford University Press
PRO	Public Record Office
RCAMW	Royal Commission on Ancient Monuments in Wales
RHS	Royal Historical Society
UCNW	University College of North Wales, Bangor
UWP	University of Wales Press
WFM	Welsh Folk Museum, St. Fagans

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Appendix 1. Glossary of Special Terms

(Abbreviations: L. = Latin; W. = Welsh)

abele	white poplar
abradico (L.)	to uproot
acer (L.)	maple
aelwyd cols (W.)	charcoal hearth
aethnen (W.)	aspen
afforest	to place an area under forest law and administration (in medieval contexts); to establish a tree crop on an area that has not carried wood for some time (in more recent contexts)
afforestatio (L.)	<u>see</u> afforest
agistator	<u>see</u> agister
agistment	herbage of a forest or the right to it; grazing dues or income from agisting
agister	forest officer responsible for agistment
allt (W.)	<u>see</u> gallt
alnetum (L.)	alder wood
amputo (L.)	to fell, to poll, to lop
arles	alder grove, alder wood
assart	land newly cleared from the waste; to clear land
avesagium (L.)	pannage
bavenum (L.)	faggot
bedwen (W.)	birch tree
billa (L.)	pick
black coal	charcoal
blattro (L.)	<u>see</u> blettro
blettro (L.)	sapling, branch
bollo (L.)	to strip branches from trees
borda (L.)	board, plank

bosca (L.)	wood, firewood
boscus (L.)	wood, woodland
broche	twigs and debris of tree
brueria (L.)	heath, heathland
brulla (L.)	small wood, coppice
brusca (L.)	brushwood, scrub
bunga (L.)	faggot
burda (L.)	<u>see</u> borda
busca	<u>see</u> bosca
cablicium (L.)	windfall wood
cadeirio (W.)	to sprout (coppice); coppice sprouting
carbo (L.)	charcoal
carbonarius (L.)	charcoal-burner
carbonator (L.)	charcoal-burner
carpentarius (L.)	carpenter
cartbote	right of tenants on a manor to take wood for repair of carts
celli (W.)	grove, small wood
celynnen (W.)	holly
cerddinen (W.)	mountain ash, rowan
chace	tract of land reserved for hunting but not subject to forest law and administration
cheminage	<u>see</u> cheminagium
cheminagium (L.)	toll paid for passage through a forest
cineres tinctorum (L.)	dyer's ashes
cipher	suppressed, thin or unsaleable stem (included with timber in a sale).
cippus (L.)	tree stump, stock
cissores bosci (L.)	sawyers, woodcutters
coal	charcoal; to make charcoal
coed (W.)	wood, woodland, timber, trees
coed cadw (W.)	reserved forest, preserved woods
coedcae, coetgae (W.)	woodfield, woodland grazing, field recovered from forest, fenced enclosure (cf. ffridd)

coeden (W.)	tree
coediog	<u>see</u> coedog
coediwr	<u>see</u> coedwr
coedlan (W.)	copse, wood, plantation
coedo (W.)	to erect timber (mining)
coedog (W.)	wooded, woody
coedwig (W.)	forest
coedwigaeth (W.)	forestry
coedwigwr (W.)	forester
coedwr (W.)	woodman; timberman (mining)
cog, cogs	roundwood or squared wood used in building up a support for the roof of a mine
cogge	small boat
cogwood	<u>see</u> cog
cogyn (W.)	<u>see</u> cog
colier coed (W.)	charcoal-burner
cols (W.)	charcoal
collen (W.)	hazel
cols (W.)	charcoal
compass timber	crooked and curved assort- ments for shipbuilding
cooperones (L.)	twigs of trees, lop and top
copare (L.)	to top, trim
coperoni	<u>see</u> cooperones
copusa (L.)	coppice
cord	stacked measure of round or cleft wood
cordwood	wood cut into short lengths and sold by the cord for charcoal-burning, fuel, etc.
cortex (L.)	bark
coti (L.)	billets
coupiatores (L.)	wood-cutters
courbe	<u>see</u> curba
crachgoed (W.)	coppice shoots
criafolen (W.)	mountain ash, rowan

croppae (L.)	twigs, lop and top
crusts	slabs, i.e. outer pieces removed first in log conversion
curba (L.)	cruck
cynnud (W.)	firewood, fuelwood
cypher	<u>see</u> cipher
deafforestatio (L.)	<u>see</u> disafforest
dean	wooded valley
decorticatio (L.)	to bark
dene	<u>see</u> dean
derwen (W.)	oak
disafforest	to release land from forest law
dolabra (L.)	hatchet
dolabella (L.)	small short-handled hatchet
dozen	charcoal measure (12 loads = 1 dozen)
essart	<u>see</u> assart
estovers	right of tenants to take wood for repair of buildings, hedges, carts, etc.
extent	survey, measurement and evaluat- ion of land
faculare (L.)	to cut up, grub up
fagetum (L.)	beechwood
fagus (L.)	beech tree
falx (L.)	billhook
falx lumaria (L.)	thorn cutter, slasher
falx putatoria (L.)	tree-pruning billhook
fasciculus (L.)	bundle, faggot
ffawydden (W.)	beech tree; used colloquially in N. Wales for pine/fir.
fforest (W.)	<u>see</u> forest
ffridd (W.)	woodland, forest; enclosed mountain pasture, sheepwalk
firebote	right of tenants on a manor to take wood for fuel
fleakes	cleft hurdles

floats	rafts
flottmaster	man in charge of raft
flotts	<u>see</u> floats
forest	1. extensive area of woodland; 2. hunting preserve of the king or a lord-marcher, subject to forest law but not necessarily woodland
forks	crucks; forked (Y-shaped) pieces
fossatores (L.)	diggers, ditchers
fraxina (L.)	ash tree
frith	<u>see</u> ffridd
fustum (L.)	log
futtock	one of the middle timbers in the frame of a ship
gad	faggot wood
gallt (W.)	wood, wooded slope
garsanese	<u>see</u> grasanese
gelli	<u>see</u> celli
germens	coppice sprouts (of oak)
gistae (L.)	joists
glans (L.)	acorn
glo (W.)	coal; charcoal
golosg (W.)	charcoal
grasanese	obligation of bondmen to feed their swine in the lord's wood
gwern (W.)	alder trees, alder grove
gwernen (W.)	alder tree
gwig (W.)	wood, forest
gwinllan (W.)	wood, copse, plantation, grove
gwŷdd (W.)	trees, wood, forest
hachia (L.)	hatchet, axe, mattock, hack
haia (L.)	<u>see</u> hay
haie (F.)	<u>see</u> hay
hand-sets	young plants from nurseries
hay	enclosure in the forest

haybote, heybote	right of tenants on a manor to take wood for making fences
hedgebote	<u>see</u> haybote
helygen (W.)	willow tree
hodd	charcoal measure, $\frac{1}{4}$ load
holo cols (W.)	charcoal hearth
housebote	right of tenants on a manor to take wood for making and repairing buildings
imp	young plant, grafted plant
impetone (L.)	enclosure for saplings
knee	piece of timber having a natural bend (for use in shipbuilding)
lappata (L.)	loppings
launds	pasture, forest pastures
lea	woodland clearing
lignum (L.)	wood
ligo (L.)	mattock
llannerch (W.)	glade, clearing
llwyfen (W.)	elm
llwyn (W.)	grove
load	wood measure (usually 50 cu.ft.); charcoal measure (variable)
loppis et toppis (L.)	lop and top
loppo (L.)	to lop
maeremium	<u>see</u> meremium
maisremium	<u>see</u> meremium
masarnen (W.)	maple —
materies (L.)	timber
mast	fruits of oak and beech (used for fattening swine in autumn)
meremium (L.)	timber
merym	<u>see</u> meremium
modulus (L.)	standard measure of wood
moket	pannage
mongwode	mixed wood

morbosium (L.)	dead wood
nemora (L.)	groves
onnen (W.)	ash tree
orles	<u>see</u> arles
pannage	feeding swine in the woods in autumn; payment for so doing
pannagium (L.)	<u>see</u> pannage
parc (W.)	park, field
pawnage	<u>see</u> pannage
paxillus (L.)	stake
peel	to bark, to strip off bark
presso(na) (L.)	acorns, beechmast
pikard	small boat
pîlo (W.)	to bark
pit-sawing	conversion of roundwood by hand-sawing in a saw-pit
planhigfa (W.)	plantation
plannu (W.)	to plant
ploughbote	right of tenants on a manor to take wood for making and repairing ploughs
powderwood	wood used for the manufacture of gunpowder charcoal
pren (W.)	tree, timber, wood
pren tafod y ferch (W.)	aspen
prysg (W.)	thicket, brushwood, scrub
prysgoed (W.)	brushwood, scrub
purlieu	land afforested (in the legal sense) and subsequently dis- afforested
purpresture	enclosure of or encroachment upon land
quadriga (L.)	4-wheel cart
quercus (L.)	oak
quisquilliae (L.)	chips of wood

ramalia (L.)	small branches, lopwood
regardatores (L.)	regarders, supervisory officers
rhisgl (W.)	bark
rundle	cylinder or roller of wood, a lopped and pollarded stem
sally	sallow willow
sartum	<u>see</u> assart
scapulo (L.)	to trim and square timber (by adze)
schrido	<u>see</u> shredding
scissores	<u>see</u> cissores
securis (L.)	axe, woodman's axe
securis dolabrata (L.)	double-bladed axe, mattock
sepes (L.)	hedge
serrula (L.)	small saw
shreading	<u>see</u> shredding
shredding	pruning, especially heavy high pruning
shrouding	<u>see</u> shredding
shrowding	<u>see</u> shredding
sigillo (L.)	marking iron
silva (L.)	wood, forest
silva regerminans (L.)	forest regenerating by seed
silva repullulans (L.)	forest regenerating by coppice
silva stolones radicibus emittens (L.)	forest regenerating by suckers
silvae caeduae (L.)	coppices
silvae glandiferae (L.)	pannage woods
silvae materiariae (L.)	high forest
silvae vulgares (L.)	forests where wood was the most important product
slang	strip of land (used as a measure of coppice)
smokesilver	payment apparently for the right of gathering firewood

spere (L.)	sapling
spina (L.)	thorn tree
sprag	short pit-prop
spring	coppice, coppice shoot
springoed (W.)	<u>see</u> spring
spring wood	<u>see</u> spring
spurn	spur root, main root
squarro (L.)	to square (timber)
stadell	standard tree
staggard	wildling transplanted into a hedge
standil	standard tree
stathelus (L.)	young tree left standing
stipes (L.)	tree trunk
stock	to clear ground of stumps
storer	standard tree
strip	to bark, to peel off bark
subboscus (L.)	underwood
summer	large beam
swinemote	court of the pannage
teller	<u>see</u> tiller
tempus pessun (L.)	pannage season
thickstuff	planking over 4 inches thick
tiller	stool shoot, coppice shoot, sucker
tornator (L.)	wood-turner
traba (L.)	beam
treenails	wooden pegs
trennals	<u>see</u> treenails
truncus (L.)	trunk, stem
trychwr (W.)	wood-cutter
ulmus (L.)	elm
venison	game animals
vert	vegetation of a forest (including trees and herbage)
viridarii (L.)	verderers

waste	unclaimed land; damage or destruction of trees etc.; <u>see also</u> crusts
weeding	frequently used in the sense of early thinning
Welsh quicksets	wildings
Weygafol	<u>see</u> cheminagium
white coal	chopped wood, slivers
white wood	broadleaved species (not oak) for charcoal-burning
windfalls	windthrown trees or branches
wixare	to weave twigs
wodegavell	<u>see</u> woodgavol
wodekevyl	<u>see</u> woodgavol
woodachet	wooden utensils
woodasken	<u>see</u> woodachet
woodgafol	money given in lieu of wood carrying services
woodhen	hen given in payment for right to gather wood
woodsilver	<u>see</u> woodgafol
woodward	forester, man in charge of or caring for woods
wormtak	payment due for compulsory feeding of swine of bond tenants in the lord's wood in autumn
wyndfal	<u>see</u> windfalls
wyures	large beams

Appendix 2. Named woods and forests in south Wales, 14th century (W. Rees, Maps of South Wales and the Border in the 14th Century, 1933)

Monmouth/Skenfrith/White Castle/Grosmont

Bucknolt Wood
Coed Anghred
Coed Belod
Coed Broyn
Coed Bychan
Coed Llanveyr
Coed Llifos
Grosmont Wood
Hodnach Wood

Bergavenny

Bloreys (the Forest)
Lyngoed
Moelyfan Forest
Tillery Forest

Usk/Caerlon/Strigoil/Trelech

Cattessaies
Coed Cwnwr Forest
Earls Wood
Forest of Weloc
Paynes Wood
Rodge Wood
Strigoil Wood
Trellech Wood
Wastacoyt
Wentwood
Wyeswood

Glamorgan

Glyntaff Wood
Glyntaff Forest
Llwynperdeit Wood
Old Forest
New Forest
Pencoed Forest
Crug Wood
Coed Franc

Gwynllwg

Coed Meredydd
Glyn Eboth Wood
Glyn Rempny Wood
Glyn Sirhowy Wood
Moelvan Forest

Gower

Kilvey Forest
Mynydd Gellionen
Tulchyclydwen Forest
Blaen Olchfa
Forest Fychan
Crow Wood
Clyne Forest

Ewyas Lacey

Forest of Ewyas
Maescoed
Forest of Monnow
Forest Hen
Forest Ollon

Carmarthen, Iscennen etc.

Pedol Forest
Brenaye Forest
Glyn Amman Forest
Maes Cathelog Forest
Glyncothi Forest
Pennant Forest
Killardun Forest
Wenallt Wood
Pencoed Forest
Cefngorach Forest
Gellyfeisant Forest
Penrhyn Forest (submerged)
Glynneiskin Forest
Forest of Glynne
Wenallt Forest
Coed y Brenin
Treskech
Glynistyn Forest
Coed yr Arglwydd

Emlyn

Garth Gyddyll Forest

Cilgerran

Cefn Drym Forest

Elfael

Old Forest

Buellt

Talyfan Forest

Blaenllwnfi

Dinas Forest

Grono Wood

Brecon

Bychlyd Forest

Cadelan Forest

Great Forest

Little Forest

Lower Forest

Upper Forest

Cantref Bychan

Crugyblaidd Forest

Forest Cefngelevarth

Pembroke

Penkelly Forest

Loydarth Forest

Narberth Forest

Coytrath Forest

Coytkellas

Kingswood

Preskely Forest

Radnor/border

Forest of Brilley

Kingswood Common

Bradnor Forest

Norwood Forest

Commergron Wood

Ackwood

Forest Fach

Knucklas Forest

Kingestell Wood

Portloke Forest

Clun Forest

Glyntoloch Forest

Hirthowel Forest

Le Tablaborn Forest

Montgomery

Forest of Cornedune

Le Lucley Forest

Appendix 3. Named forests and major woods in the maps of Saxton and Speed, and George Owen's 'Description of Wales'.

County	Saxton 1578	Owen* 1602	Speed 1610
Anglesey		Coedkadv	
Brecon		Forest y Brenin Dyvynnog	
Cardigan	The Forest (Llanbeder) Rescob Forest	Forest yr Esgob Coedmor Coedylllys	The Forest (Llanbeder) Rescob Forest
Carmarthen	Cardyth Forest	Caerdyth Parkryn	Cardyth Forest
Denbigh		Coed or llwyn	
Glamorgan	Forest Coidfrank	Coed phrank Coed iarlh	Coidfrank Forest
Merioneth	Benrose Wood	Berwyn	Benrose Wood
Monmouth	Erleswood Wensewood Wiesewood Chase	Earles woodde wentes woodde Wyes woodde Monckes woodde Grismond	Erles Wood Wense Wood Wiesewood Chase
Pembroke	Coidrath Forest Narbarth forest	Coed traeth (Coed yr haf) Narberth (Arberth) Kilgarran Kilrhyth Penkelli Mynwer Picton wodde Pentre Ivan woodde	Coidrath Forest Narbarth Forest
Radnor	Forest of Knukles Radnor Forest Forest of Blethuagh	Knukles Forrest Radnor Forrest Blethuach Forrest	Knockles Radnor Blethvaugh

*For discussion of these woods and forests, see Henry Owen's notes in Cymmrod. Record Series No. 1, Parts III & IV.

Appendix 4. Named forests and woods in Glamorgan, 1578
 (Rice Merrick, A Booke of Glamorganshire's
 Antiquities)

Forests

Keven y Vid.
 Keven on
 Bed Merchan
 Gelenog
 Glintaf
 Lloydcoet
 Glin Kynon
 Arthmaylog
 Arthgriffry
 New Forest
 Ould Forest
 Bery

Woods

Lanissen
 Kayre
 Lekwyth
 Pencottry
 St Fagan's
 Ridlaver
 Pendrebaen
 Riglin
 Yechan
 Gwer^m de Gay
 Koed Maur
 Y Kottrell
 Y Kynehed
 Hornby
 Barry
 Penmarke
 Cam Lloyd
 Lanvithin
 Kad
 Brinhelygen
 Talavan
 Wern Vraits
 Kraplif
 Sor
 Landavan
 Koed Must
 Koed Melwas
 Krycke
 Coed Franke

Appendix 5. Named forests and woods in Pembrokeshire,
1603 (George Owen, Description of
Penbrokeshire)

The best standing woods

Narberth forest
Killgarran
Coed Traeth
Caneston
Mynewer
Penkelly
Killreth
hook wood
Vpton

Forests & woods now destroyed

lloydarch forest
Rywgian
Moelgrove
Coed Cadw
Coed llong
Mouncton park
The wood by Newe gall
Cron lloyn

Smaller woods

Picton
Boulston
Wiston
Throstlwoode
lloyn gwayr
western Trewgarne
Estern Trewgarne
Coed kynles
llannerche
Killkythed
Diffryn gwayn
Argoed
Henllis
Wenallt
Beinton
Rams Bushe
Perskyly
vper Talch
Nether Talch
Creswell
Mote
Walton
Woodstock
lloyn y gorres
Drym
Nashe
langom

For identification of these woods, see Henry Owen's notes
in Cymmrodorion Record Series No. 1 Part I pp. 86-7.

Appendix 6. Woods named in Edward Lhuyd's Parochial Queries (1696).

Parish	Wood
Llanelltyd (Merion.)	{ Koed y Ganlhwyd Koed y Berthlwyd Koed Dol y Melynlhyn Koed yr Hengwrt Koed y Vanner
Llanrwst (Denb.)	Koed Karreg y Walch Koed Bryn Sylhty Koed y Gweilch Koed Nant Goron
Llanddoged (Denb.)	Koed Gronant Koed y Gorswen Koed Kaer hyn Koed havod y Klawdd
Abergele (Denb.)	Koed y Plâs ycha Koed Syrrie Keivronnydh
St. Asaph (Flint)	Koed Kil Owen
Dyserth (Flint)	Koed Gwylin
Prestatyn (Flint)	Koed yr Esgop
Llanasa (Flint)	Coed gwilin Coed pant y Lhawndy
Caerwys (Flint)	Koed y Pwlh gwyn
Bodfari (Flint)	Park Koed pont Ryffydh Koed y Lhan
Holywell (Flint)	Greenfield Wood Bagylht Wood
Ysceifiog (Flint)	Coed bron Vadog
Nannerch (Flint)	Koed y Gelhi
Cilcain (Flint)	Koed Plâs newydd Koed Merklas
Flint (Flint)	Koed onn Koed Bryn y Garreg

Parish	Wood
Hawarden (Flint)	Ewlo wood
Henlan (Denb.)	Koed Panton Koed yr Eivied Koed Lhannerch Koed Lhyweni Koed Gwaenynog Koed Bod Eliog Koed Rhŷd Gôch
Llandrhaiadr yn Cinmerch (Denb.)	Koed Lhywesog Koed Nant-Mawr Park Koed orlhwyn Y Koed dŷon Y Koed ystig Koed Syl Koed Kae'r havod Koed maes Annod
Bryneglwys (Denb.)	Koed Bryn Tangor Koed y Plâs yn Iâl
Llantysilio (Denb.)	Koed y Geveliae
Bangor (Flint)	Tir y Prenniae
Hanmer (Flint)	Halghton Wood Hanmer wood Betchfield
Gresford (Denb.)	Koed y Person Koed Trevor Koed y Brain Koed y Kopi Koed yr Akrae Koed y Kox
Llanfair Dyffryn Clwyd (Denb.)	Koed Kochion (alias K. Plâs ennion)
Llanefydd (Denb.)	Koed yr Henvron K. pen Porchell
Aberllynfi (Brec.)	Coed bolyn
Glasbury (Rad.)	Coed y marchog Gerndhover

Parish	Wood
Bleddfa (Rad.)	Koed y forest y mynachdy
Llanddewi Ystradenny (Rad.)	Fforest y Knucklas
Llangollen (Denb.)	Forrest y Krygnant Koed Pengwern
Corwen (Merion.)	Park Glyndowerdwy
Llanfor (Merion.)	Koed Rhiwedog Koed y Rhiwlas Kam yr wyll
Llangower (Merion.)	Koed y vron
Llanfrothen (Merion.)	Koed dû Koed y rharad Y Keunant koch Koed Tyddin y sais
Trelech (Monm.)	Wisewood
St. Clears (Carm.)	Priory Wood
Llantilio Pertholey (Monm.)	Gwern pen y clawth
Walwyn's Castle (Pemb.)	Sichwood