THE ANCIENT OAKWOODS OF CADZOW AND GARSCADDEN

THEIR HISTORY, ECOLOGY AND CONSERVATION

by
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ABSTRACT

Two of the fragments of ancient woodland in the Glasgow area are investigated with respect to their history, ecology and conservation.

The ancient oaks at **Cadzow**, near Hamilton, are described. They are notable in their size, their twisted growth forms ("stagheadedness") and their apparent age. There are now about 300 trees in an area of wood pasture. The exact specific status of the oaks is considered. Detailed morphological analysis shows that they exhibit characteristics of both Quercus robur and Q. petraea although they show more characteristics of the former. It is suggested that they are the product of hybridisation, followed by introgression with Q.robur.

The past management of the oaks is investigated. Historical references to the oaks exist in both published literature and in surviving estate records. These show that the trees have been valued for centuries and that they were formerly an integral part of the Dukes of Hamilton's chase, wild white cattle and deer being the animals hunted. There is no documentary evidence for the belief, which is widely held today, that the trees were managed by pollarding and that this has resulted in their unusual habits. An analysis of annual rings, from samples dating back to 1444, confirms the absence of pollarding.

Old maps show the presence of the oaks from the late 16th Century onwards and it is concluded that there is a high probability that the oaks originate from primaeval woodland. Individual stumps can be dated back to the 15th Century and it is probable that some of the existing trees pre-date this, possibly by several centuries.

In view of their great antiquity and virtually unique status as an area of ancient wood pasture in Scotland it is essential that they are protected. Strategies for their future conservation are considered.

Garscadden Wood, on the outskirts of Glasgow, is of interest for very different reasons. Outwardly unremarkeable, with a canopy of maiden oaks (age c.120 years) and many planted exotics it is easily overlooked as an area of ancient woodland. In addition there is a certain amount of damage and vandalism in the wood, yet there can be no doubt of its importance.

The wood is present on maps from the 18th Century onwards. Inside the wood there are some large oak rings, interpreted as having been produced through repeated coppicing. Many of these

are probably in excess of 400 years old. Documentary evidence of the age of the wood is sparse, with few references to Garscadden Wood in published literature and no surviving records from the former estate of Garscadden.

A detailed survey of Garscadden Wood was carried out in order to disentangle the confusing array of earthworks found in it - boundary ditches, drainage ditches and ridge and furrow. A detailed map of the wood, showing earthworks and ancient trees was produced, as was a map showing the age of the different parts of the wood. It is clear that there is an ancient inner core where the old trees are found and this is bounded by a, now incomplete, woodbank. The wood was enlarged in the 19th Century and new areas of former farmland were incorporated.

Some aspects of the present ecology of Garscadden Wood are considered - the pattern of oak regeneration (mainly in cleared areas of the wood), the flora of the wood and whether this is related to its ancient status, the unusual horizontal oaks which have resprouted and now form "linear thickets", and the effect of building the nearby Drumchapel housing estate. Future management of the wood is considered with particular reference to an existing management plan. Little immediate threat to Garscadden Wood is apparent. Nonetheless it is suggested that it should be designated a local nature reserve. This would allow for a more certain future and its value would be more widely appreciated.

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CONTENTS

INTRODUCTION

Old woods and old trees have a peculiar fascination. The fact that a piece of ground may have been continuously wooded since the time of the Ice Age, or that individual trees may date back over centuries, has long intrigued man. Such woods are becoming rarer as they are gradually cut down or underplanted; yet vestiges do remain.

In the vicinity of Glasgow there are many areas of woodland which may superficially appear to be very old. Comparison of an 18th Century map and a modern one will show a certain degree of overlap. Within Glasgow and its immediate surrounds there are at least a dozen areas which were wooded in 1750 and where some woodland can still be found today. Examples include Crookston Wood, Bull Wood, Templehill Wood and Mugdock Wood, in addition to the two areas studied for this thesis - the oaks at Cadzow and Garscadden Wood.

Roberts **et al** (1992) have calculated that Strathclyde, Central and Highland Regions are the parts of Scotland with the greatest amounts of "ancient" woodland. This is in fact a very small proportion of the Region - only 2.2% of Strathclyde - but it compares favourably with some other areas eg. Fife Region (0.3%), Borders Region (0.4%). Even within Glasgow District

0.7% of the land is covered by ancient woodland. This should be seen in the overall context that c.14.5% of Scotland is wooded in some form but that overall only 1.9% of the total land area is ancient woodland.

The precise definition of "ancient" woodland is discussed later but it is evident that some apparently old woods are of more interest than others. Crookston Wood demonstrates this very clearly - all the original trees have at some stage been removed and it is now a stand of planted conifers. In Templehill Wood and Bull Wood the vegetation has not been so drastically altered. Nonetheless, surface earthworks in the woods indicate that parts of both woods have been cleared of trees at some stage and turned over to cultivation. Cooke and Bowsher (1987) class Templehill Wood as a long-established wood of plantation origin.

For this research it was decided to concentrate on two very different areas. The Cadzow oaks do not form a dense wood but are now scattered trees standing on farmland. Yet this is a fascinating area of very ancient trees and represents an almost unique example of ancient wood pasture in Scotland. Very little has previously been written about them. The other area is Garscadden Wood; this is marked on 18th Century maps yet its history is complex. In the wood there are old oak trees but, in marked contrast to the Cadzow oaks, they are more or less inconspicuous.

For each of these two areas the aims were as follows:

1. to study the area as it is now and to attempt to explain its origin

ie. to account for the trees which are there - their age, their growth habit, their management in the past etc.

2. to assess the importance of the site for conservation and as a site of natural heritage.

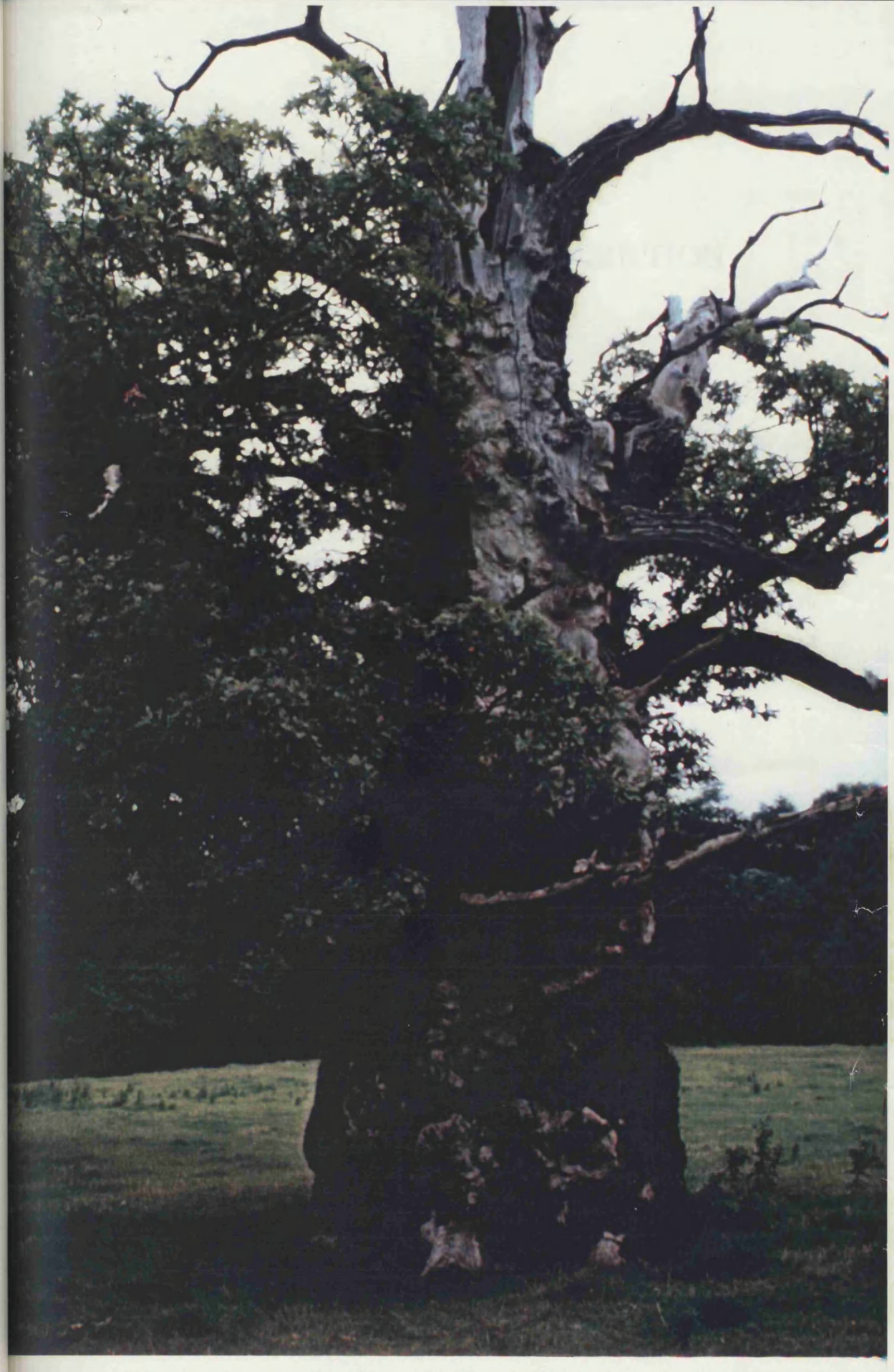
3. to discuss its future and the strategies that might be employed for its future management.

In both cases the more the trees were studied the more intriguing and important they were found to be.

PART A

THE CADZOW OAKS

Plate 1 (over) shows one of the "stagheaded" oaks; the upper crown has sufferred severe dieback but the lower boughs remain healthy.



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THE CADZOW OAKS - A DESCRIPTION

Even the most casual observer cannot fail to be struck by the appearance of the Cadzow oaks. Seeing these trees in winter one might assume them to be dead - bizarre shapes with hollow trunks and jagged crowns. However each spring there is a stubborn new growth of fresh healthy shoots, their lush greenness contrasting starkly with the wrinkled grey bark and the rust-coloured centres of the split-open trunks.

These trees are mostly scattered over farmland just south of Hamilton in an area known as Hamilton High Parks. This was formerly part of an estate belonging to the Dukes of Hamilton which also included Hamilton Palace (now demolished) and also Chatelherault. The latter was built between 1732 and 1744 as the hunting lodge of the Dukes of Hamilton. In 1978 some of the former estate was acquired by Hamilton District Council and it is now managed as a Country Park. Chatelherault, the hunting lodge after which the Park is named, has been restored and now serves as a Visitor Centre. A few of the ancient oaks (less than ten) are in the Country Park but the majority are within the grounds of the neighbouring High Parks Farm which was also sold when the estate was dissolved in 1978.

The present condition of the trees, and possibly even their very survival, may have depended on their presence within this estate and the management of it. Estate records (see page 42) show that they were an integral part of the Dukes' chase or park. White cattle were kept here and grazed among them.

Areas such as these were of great importance to the nobility in medieval Britain. Parks were enclosed areas set aside specifically for the purpose of hunting, such as this area near Chatelherault. Similar in purpose although differing in detail were "Forests". In the original sense these were "a place inhabited by the king's (or some other lord's) deer " - Rackham (1980, page 175). Referring to these he says that "a Forest was the supreme status symbol of the noblest families" (page 177). Elsewhere (Rackham 1989) he states that the forest system flourished and survived much longer in Scotland than in England. (Oliver Rackham is widely regarded as the leading expert on historical ecology and ancient woodlands in Britain and he has published a large number of works (eg. Rackham 1975, 1976, 1980, 1986, 1989, 1990, 1994.) The most recent includes a brief description of the Cadzow oaks; these works are often referred to in this thesis.) The importance of forests is confirmed by Gilbert (1979) who states that in medieval Scotland barons probably spent more time and effort on hunting than on any other activity.

Many of the Cadzow trees are quite small and there are only a few of the c.300 trees with a full spreading crown. The majority suffer from very severe "stagheadedness" - the uppermost boughs are long dead, only jagged branches remaining, and whole portions of the crown are entirely absent. Indeed some of these trees measure no more than 3m in height and are only 3-4m in the diameter of their crowns. Although most are significantly bigger than this, Rackham (1990) describes this stagheadedness as a normal feature of tree development - the tree "reduces its commitments" and can thereafter grow a new crown should conditions improve.

Virtually all the trees share this stagheadedness and none are large, typical "parkland" oaks. This may largely be attributable to their undoubted age although various other possibilities exist (see page 11). Closer inspection of the trees shows that there are essentially two main groups:

A) "Bottle-shaped trees" ie. somewhat swollen at the base with relatively short stumpy trunks (Plates 1 and 2b). The boles of these trees are often densely covered in an epicormic growth, although there may be a pronounced browse line below which the growth consists only of bare twigs.

Burrs and ridges on the lower trunk, from which the epicormic growth originates in these trees, have been described by Rackham (1990) as features which are normally

genetically determined. They allow a tree to recover and regrow a new crown following damage to its existing crown. Partly because of the presence of these massive outgrowths on the trunks many of the Cadzow oaks have attained an enormous girth. In his description of the British species of Quercus Jones (1959) states that both species of oak ie. Q.robur and Q.petraea, occasionally attain girths of 35 - 40 feet but that "girths greater than 20 feet seem to be exceedingly rare in Scotland". As the following table of some representative "type A" and "type B" trees shows there are oaks at Cadzow which comfortably exceed this.

TREE NAME	TYPE A or B	G.b.h. * (ft and cm)	Height (m)	Crown diameter (m)
A	**A**	24'(730cm)	7.3	17 x 14
B	**A**	19'(570cm)	11.0	14 x 9
C	**A**	23'(680cm)	7.0	15 x 10
D	**A**	25'(760cm)	10.2	12 x 11
E	**B**	15'(470cm)	12.0	11 x 9
F	**B**	20'(610cm)	16.8	17 x 17
G	**B**	13'(400cm)	7.3	11 x 8
H	**B**	11'(330cm)	7.6	9 x 7

*NB. G.b.h = Girth measured at breast height
Height estimated by eye.
Crown diameter estimated by measuring the area under the crown at its two widest extremes.

What is equally striking is that these enormously wide trunks are actually very short and are topped by small, broken and open crowns.

B) More upright and slender trees, often slightly sinuous in shape, the crown sometimes, but not always, more open with a lower twig density (Plate 2a and 3b).

First impressions might suggest that these trees are simply not of a great age and hence have a narrower, less gnarled trunk. However analysis of cut stumps shows that this is not the case. A simple count of the annual rings shows that girth and longevity are not always correlated. A spectacular example of this is the cut stump of an oak which has at least 440 annual rings yet this stump is small - the girth at 40cm above ground is only c.12' (406cm). The girths listed above are all at breast height and so a comparable value for this tree would in fact be slightly **less** than this figure.

Interestingly this tree stump is long dead with all the sapwood absent but one can still make an estimate as to when it began its life. Oliver Rackham has estimated that stumps like this at Cadzow probably had about 30 years of sapwood, now absent, and that it would require approximately 60 years for this sapwood to decay completely (personal communication). If these figures are added to the known number of years of growth for the stump itself (>440) an overall figure of 530 years is produced. This would imply that the tree began growth in approximately 1460. As the dated graphs of ringwidth for some of these cut stumps show several of the Cadzow oaks undoubtedly

did begin growth at roughly this time eg. this stump could well be Baillie's q2818 (see page 69).

These "type B" trees may in some cases appear outwardly more intact and healthy than the type A trees however closer inspection almost always revealed that they too were hollow in the centre of their trunks. The main difference between the two types of trees may simply be that these trees are not covered in the burrs, ridges and dense epicormic growths so characteristic of the "type A" trees.

POLLARDING OF THE OAKS

It has been suggested that the reason for the unusual growth habits of these trees is that they were pollarded regularly in the past. A pollarded tree is one which has had its boughs lopped off at a height of 2 - 3m above the ground. This provided a renewable source of wood since the tree would normally regrow the missing branches and produce a new crown. Referring to Cadzow, Kirby (1989) states:

> "the site is a parkland, the trees have been managed in part by pollarding in the past. However they are not the typical pollards found in many southern woods with a short bole topped by half a dozen large branches."

Despite the slight reservations of some such as Kirby it has

become accepted by others that this is the main reason for the shapes of the trees today eg. the Hamilton District Council guide to Chatelherault Country Park states that "their rather dumpy appearance is due both to the nature of the trees and to the fact that they were pollarded" (Hamilton District Council 1988).

Certainly pollarding was a common practice in uncompartmented wood pasture systems such as medieval parks and forests (Rackham 1980). The reasons for this are clear - in an uncompartmented wood pasture this was the simplest way of obtaining wood for various purposes eg. for tanning bark and for providing browse wood for the park animals in winter (Rackham 1980). An uncompartmented area was one in which the animals were free to roam throughout the wood and were not excluded from any area. Pollarding ensures that the trees can regrow new branches even in the presence of these animals, whereas most other methods of harvesting the timber require subsequent exclusion of animals if new branches are to grow. Young seedlings or coppice shoots, which would be essential for the production of new timber if the trees were cut at ground level, would have little chance of survival if the animals of the park were not excluded. There is no evidence to suggest that any such compartmentation was practised at Cadzow (see page 42) therefore pollarding would have been a logical management technique.

If a tree is pollarded repeatedly an unusual shape will undoubtedly result. The bole becomes disproportionately large in comparison to the upper branches and the crown itself may be rather dense. Numerous branches sprout from the level at which the trunk was cut.

Are then the shapes of the Cadzow oaks consistent with such treatment? In many of the trees the absence of portions of the crown makes this visual analysis problematic but my subjective feeling is that in only a few cases is there any real evidence of pollarding. One such tree is shown in Plate 3a. In total there are probably only eight of the oaks whose shapes are clearly compatible with past pollarding (also see Rackham 1994).

Shredding (sometimes referred to as high pollarding or giraffe pollarding) was another renewable method of obtaining wood from trees in the presence of grazing. In this case the main trunk was left intact for its whole height and branches were then lopped off it. What one would then expect to result would be a taller tree than a pollard with a gradually tapering trunk and numerous disproportionately small branches emerging from it all the way to the top. Some of the Cadzow oaks have a shape somewhat reminiscent of this. Kirby (1989), who has already been quoted as saying that the trees may have been pollarded, adds:

"Possibly they were shredded or perhaps a few are genuine

remnants of formal high forest trees, isolated by parkification and slowly decaying since. Only a detailed historical study will show."

However in the absence of other known shredded trees for comparison hypothesising that shredding was practised on some of the trees in the past must be very tentative.

Interestingly there are also two hawthorn trees among the old oaks which may be pollards. Oliver Rackham states that they may be of considerable age and that comparable trees in S.England can be 300 years old or more (personal communication).

In order to clarify the way in which these trees have been managed in the past various other aspects of their biology were studied. Initially it was essential to establish which of the species of oak they were. Thereafter an analysis of the annual rings of the trees was undertaken. Historical records and old maps were also studied for information about the past life of the trees.

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TAXONOMY

INTRODUCTION

The taxonomy of the oak tree in Britain is far from straightforward. "A story of confusion and disagreement" is the way in which Gardiner (197c) sums up the history of the classification of oaks. The main problem area concerns possible hybrids between the two species - **Quercus robur**L. and **Quercus petraea** (Matt.) Liebl.

Jones (1959, page 198) argues that the 2 species of oak are always recognisable as individual species and that hybridisation is not a common phenomenon :

> "The frequently-made statements to the effect that in natural populations hybrids are very abundant and that intermediates often predominate have insufficient foundation, and are mostly based on imperfect understanding of the specific characters."

Cousens (1962), working initially on oak trees in Scotland, found himself at odds with this assertion. He states that using Jones' criteria it was virtually impossible to find homogeneous stands of trees with clear Q.robur characteristics.

Instead he found a predominance of trees which exhibited intermediate characteristics and which would therefore appear to be hybrids. This was even after widening the criteria by which Q.robur could be recognised. After a further study he concluded that the proportion of hybrids in Scotland was at least 50% and probably 75% (Cousens 1963).

The presence of large numbers of hybrids has been confirmed by others, eg. Wigginton and Graham (1981, page 71) state the following:

> "There is considerable hybridisation and introgression between our two native species of oak. Trees with intermediate characters are widespread and common in our region (ie. North England) and are variable and fertile."

They do however acknowledge that the situation is not simple:

> "The limits of the true species, and the extent of mixing are still a matter of opinion."

Reviewing all the literature on the hybrid controversy Gardiner (1974, p151) states:

> "There can now be few doubts remaining that, in some, but not all, areas of Europe and Scandinavia where the two species occur together, either naturally or artificially, extensive gene exchange takes place between Pedunculate and Sessile oak."

Jones (1959) states that there is some evidence of a fertility barrier between the two species. He cites the experiments of Dengler (1941). His experiments certainly show that there is a low rate of cross fertilisation - no more than 4% of the pollen of one species germinated on the stigma of the other - but this must be seen in the context of his other results. The success rate of crosses within the one species was sometimes only 29% and only in one case was it greater than 50%. A significant difference between intra- and inter-specific pollination does obviously exist but it should not be concluded from these results that hybrids will never occur.

Cousens (1963) suggests that even if the occurrence of successful crosses was low the present population structure (ie. with numerous intermediates) could still have arisen in this way. Once a hybrid had been formed there would be a high degree of compatibility with either of the parents and subsequent progeny would be partly formed from this intermediate gene pool. Introgression of genes form one parent into the gene pool of the other would then be occurring. He further points out that, such is the variability of Q.robur, large differences between individuals' ability to cross fertilise are likely.

Subsequent work by Cousens on pure Q.robur populations, where there was no suggestion of hybridisation, caused him to modify this opinion slightly (Cousens 1965). He formed the

opinion that the high degree of variability in Q.robur populations was not due to introgression, rather it is simply a highly variable species. On the other hand he still maintained that many of the Q.petraea populations in Scotland did appear to be highly introgressed in comparison with Q.petraea populations elsewhere.

Indeed it would appear that introgression of oaks is more common in Scotland, and possibly also in the North of England, than in more southerly latitudes. Cousens (1965) points out that on the continent the two species are virtually sympatric and yet have maintained their separate identities in a way that has not occurred in Scotland. Two possible reasons for their remaining as separate species are given:

a) partial intersterility

b) distinct ecological requirements, in particular the ability of Q. robur to withstand waterlogged soils whereas Q.petraea cannot.

These two factors would be equally applicable in Scotland and so some other factor must be responsible for the hybridisation found here. One possible difference given by Cousens is that the shorter growing season in Scotland may result in a greater overlap in flowering times between the two species and this would increase the likelihood of crosses should the two species be found together. This explanation is discounted by Stace (1975) who claims that there is always at least a 50% overlap between the flowering times of the two species.

It is possible that, in Scotland, the particular history of oak planting has resulted in the two species growing together, thus making hybridisation more likely. Anderson (1967) states that Q.robur was planted in preference to Q.petraea. Further illustrating the complexity surrounding the taxonomy and biology of this genus, it is worth considering the opinion of Anderson that Q.robur is not an indigenous species in Britain at all (Anderson 1950). Describing Wistmans Wood in Devonshire (Anderson 1954), he explains the presence of Q.robur in what is apparently a "virgin" wood (Tansley 1939) as being the result of "avificially" spread (ie. bird-carried) acorns from a nearby Cistercian monastery. No evidence is cited and it is stated as purely conjectural. He is of the opinion that Q.robur is not a native species.

The idea is completely rejected by most ecologists eg. Rackham (1980) points out that most ancient oaks are Q.robur (as is largely the case at Cadzow - see page 29) and that it was evidently common well before there is any recorded tree planting. Whether or not this is true, the planting of this species in areas otherwise occupied by Q.petraea would certainly provide the opportunity for increased hybridisation.

THE CADZOW OAKS

What then of the Cadzow oaks? Are they indeed Q.robur as stated in the Chatelherault Country Park literature (HDC 1988)? A cursory glance showed that a more detailed study was necessary:

METHOD OF SAMPLING AND IDENTIFYING

In August 1990 samples of 43 trees were cut and pressed. Wherever possible the sample included some acorns on their stalks.

Some of the most important characteristics used for species identification are listed in the table below:

CHARACTER	Q.robur	Q.petraea
LEAVES		
a) Shape	Obovate	Elliptical
b) Lobe regularity	Irregular	Regular
c) Lobe depth	Deep	Shallow
d) Lobe pair number	3-5(-6)	5-6(-8)
e) Venation	Some veins to sinuses between lobes	No veins to sinuses
f) Base of leaf	Narrow; cordate, strongly auricled	Cordate to cuneate weakly auricled
g) Petiole	Short; (0-)2-3(-7)mm	Long; 13-25mm
h) Pubescence of abaxial surface	Normally glabrous, some simple hairs	Simple hairs abundant; stellate hairs on lamina
FRUITING CHARACTERS		
a) Peduncle length	2-9cm	0-3(-4)cm
b) Peduncle pubescence	Glabrous	Clustered hairs
c) Acorn colouring	Olive-green stripes on fawn background	Dark brown; no stripes

Based on Jones (1959, 1968), Warburg (1962),Cousens (1963), Carlisle and Brown (1965) Wigston (1975) Wigginton and Graham (1981).

It was immediately apparent that a simple subjective analysis would be inadequate to determine which of the two species these trees were (or some intermediate). Therefore ten of these samples were examined in detail, each of the

leaves on the sample branch being considered individually, with the aim of producing a numerical index as follows:

Six of the main leaf characteristics and two fruiting characteristics were chosen and for each of these characteristics 3 possibilities were described:

typical of Q.robur eg. long peduncle
intermediate in character eg. medium length peduncle
typical of Q.petraea eg. short peduncle.

Then in order to produce an overall numerical hybrid index each of the 3 categories was awarded a numerical value as follows:

typical of Q.robur - given a score of 1
intermediate in character - given a score of 2
typical of Q.petraea - given a score of 3

Thus, theoretically, a pure specimen of Q.robur would score 1 for each of the 8 characteristics and would have a final score of 8 (8 x 1). Equally a pure specimen of Q.petraea would have a final score of 24 (8 x 3) and hybrids would have scores ranging between these two extremes.

The eight characteristics and their 3 categories are listed below (based on Wigston 1975):

1. PETIOLE LENGTH AS A PERCENTAGE OF THE TOTAL LEAF LENGTH (hereafter referred to as PETIOLE PERCENTAGE)

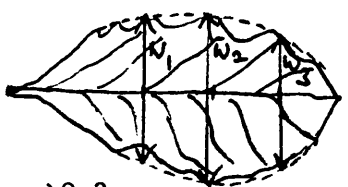
$$\text{PETIOLE PERCENTAGE} = \frac{\text{petiole length}}{\text{total leaf length (petiole + lamina)}} \times 100$$

PETIOLE PERCENTAGE = <7% -------score of 1 (aff.Q.robur)
PETIOLE PERCENTAGE = 7%-10%-----score of 2 (intermediate)
PETIOLE PERCENTAGE = >10%-------score of 3 (aff.Q.petraea)

2. LEAF SHAPE

$$\text{Leaf shape index} = \frac{W_3 - W_1}{W_2}$$ ie.numerical description of whether leaf is obovate or elliptical

where these values are the width of the leaf at its middle and near the ends as follows:



LEAF SHAPE INDEX = >0.3--------score of 1 (aff.Q.robur) (obovate)
LEAF SHAPE INDEX = 0.1-0.3-----score of 2 (intermediate)
LEAF SHAPE INDEX = <0.1--------score of 3 (aff.Q.petraea) (ellipt.)

3. LOBE REGULARITY AND DEPTH

LOBE DEPTH > **50%** OF LEAF WIDTH & LOBING **IRREGULAR** --score of 1 (aff.Q.robur)
LOBE DEPTH < **50%** OF LEAF WIDTH & LOBING **IRREGULAR**
or
LOBE DEPTH > **50%** OF LEAF WIDTH & LOBING **REGULAR** ----score of 2 (intermediate)
LOBE DEPTH < **50%** OF LEAF WIDTH % LOBING **REGULAR** ----score of 3 (aff.Q.petraea)

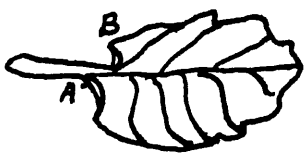
4. LOBE PAIR NUMBER

LOBE PAIR NUMBER = ½(total lobe number)

LOBE PAIR NUMBER < 5 ----------score of 1 (aff.Q.robur)
LOBE PAIR NUMBER = 5 ----------score of 2 (intermediate)
LOBE PAIR NUMBER > 5 ----------score of 3 (aff.Q.petraea)

5. SHAPE OF LEAF BASE

Strong auricles with points, often overlapping the petiole ----score of 1 (aff.Q.robur)
Margins strongly reflexed but point B above point A (see diagram below) ; points always present although weak reflexion possible ------score of 2 (intermediate)
Auricles absent or weak ---score of 3 (aff.Q.petraea)



6. ABAXIAL PUBESCENCE

Stellate hairs absent ----------score of 1 (aff.Q.robur)
Stellate hairs present ---------score of 3 (aff.Q.petraea)

7. PEDUNCLE LENGTH

PEDUNCLE LENGTH > 3cm --------- score of 1 (aff.Q.robur)
PEDUNCLE LENGTH 2-3cm --------- score of 2 (intermediate)
PEDUNCLE LENGTH < 2cm --------- score of 3 (aff.Q.petraea)

8. PEDUNCLE PUBESCENCE

Peduncle glabrous ---------- score of 1 (aff.Q.robur)
Clustered hairs present ------ score of 3 (aff.Q.petraea)

The **Hybrid Index** was calculated by taking the average leaf score for each tree (based on the 6 characteristics) and adding to it the scores for the 2 fruiting characteristics.

Time did not permit such a detailed analysis of all the remaining 33 samples and a slightly less detailed method was employed for these. Each individual tree was still given a score of 1 - 3 for each of the 8 characteristics and a final

species score produced but it was based on a more subjective assessment of all the leaves on the branch and no actual measurements were made.

In order to assess the reliability of the two methods of analysis some "standards" were analysed. These were specimens identified by P.D.Sell of Cambridge University Herbarium as being Q.robur, Q.petraea or Q.rosacea (ie. hybrid). A hybrid index score was calculated for each of these using the full detailed analysis and also the more subjective method of analysis.

Some more samples were then taken in August 1991 but this time the method of sampling was different. Cousens (1963) states that morphological variation within a tree is considerable and therefore the particular leaves for analysis should be selected with care. It is claimed that mid-shoot leaves are most representative. Lammas shoots should be avoided and the part of the crown from which the leaves are taken is also important. He claims that the greatest contrast between the two species is found on the south-east side of the tree at a height of 6m. Accordingly this second sample of leaves were removed using a long-handled polecutter and each of these criteria were fulfilled.

RESULTS

All the results are summarised in the following tables:

TABLE 1 - detailed analysis (9 trees)

TABLE 2a - simple analysis (34 trees)

2b - simple analysis, trees sampled in the precise method specified by Cousens (above)(17 trees).

TABLE 3 - analysis of standards (4 trees)

TABLE 1 - DETAILED ANALYSIS OF 9 TREES

	Petiole length (mm)	Total leaf length (mm)	% petiole	Score	Leaf width W_3 W_2 W_1 $\frac{W_3-W_1}{W_2}$	Score	Lobing > or < 50%	Lobing reg or irreg	Score	Lobe pair no.	Score	Auricle score	Pubescence score	TOTAL LEAF SCORE
TreeA1														
Leafa	3	53	5.7	1	31 31 25 0.19	2	<	reg	3	3	1	1	3	11
b	6	70	8.8	2	42 36 20 0.61	1	<	reg	3	3	1	1	3	11
c	7	90	7.8	2	56 56 42 0.25	2	<	reg	3	5	2	2	3	14
d	7	86	8.1	2	52 52 36 0.31	3	<	reg	3	4	1	1	3	13
e	3	84	3.6	1	39 44 34 0.11	2	<	reg	3	5	2	2	3	13
f	6	84	7.1	2	50 52 30 0.38	1	<	reg	3	4	1	1	3	11

Average leaf score = 12.1

peduncle 20mm -> **score = 2**; glabrous -> **score = 1.**

HYBRID INDEX = 15.1

Tree A2														
Leafa	5	75	6.6	1	34 36 27 0.20	2	>	irr	1	4	1	2	1	8
b	5	75	6.6	1	33 37 30 0.08	1	<	irr	2	4	1	2	3	10
c	4	52	7.7	2	21 23 18 0.13	2	<	reg	3	3	1	2	3	13
d	6	74	8.1	2	25 34 33 -0.2	1	<	irr	2	4	1	2	3	11
e	6	90	6.7	1	39 42 32 0.16	2	>	reg	2	4	1	1	3	10
f	7	83	8.4	2	34 40 31 0.08	1	>	irr	1	4	1	2	3	10

Average leaf score = 10.3

peduncles 17mm, 15mm -> **score = 3**; both pubescent -> **score = 3.**

HYBRID INDEX = 16.3

Tree A3														
Leafa	4	80	5.0	1	50 45 37 0.29	2	</>	irr	2	5	2	1	3	11
b	3	70	4.2	1	33 39 29 0.10	3	<	irr	2	3	1	1	3	11
c	7	89	7.9	2	52 47 35 0.32	1	</>	reg	2	4	1	1	3	10

Average leaf score = 10.7

peduncle 20mm -> **score = 2**; glabrous -> **score =1**

HYBRID INDEX = 13.7

Tree 8265														
Leafa	6	123	4.8	1	62 69 50 0.17	2	>	irr	1	3	1	1	3	9
b	5	111	4.5	1	59 68 44 0.22	2	>	irr	1	3	1	1	3	9
c	6	93	6.4	1	39 55 45 -0.1	3	>	irr	1	2	1	1	3	10
d	6	123	4.8	1	55 71 49 0.08	3	>	irr	1	3	1	1	3	10
e	7	104	6.7	1	44 31 32 0.45	1	<	irr	2	5	2	1	1	8
f	6	97	6.2	1	41 40 32 0.22	2	<	irr	2	4	1	2	1	9
g	5	86	5.8	1	38 51 44 -0.1	3	>	irr	1	2	1	1	3	10

Average leaf score = 9.3

peduncle 51mm -> **score = 1**; glabrous -> **score =1**

HYBRID INDEX = 11.3

Tree 8306														
Leafa	10	123	8.1	2	62 68 47 0.32	1	<	reg	3	4	1	2	3	12
b	9	96	9.3	2	44 56 44 0.00	3	<	reg	3	4	1	2	3	14
c	10	105	9.5	2	44 63 52 -0.1	3	<	irr	2	4	1	1	3	12
d	10	120	8.3	2	62 75 70 -0.1	3	<	reg	3	5	2	1	3	14
e	10	110	9.1	2	53 60 46 0.12	2	<	reg	3	5	2	2	3	14

Average leaf score = 13.2

peduncle 42mm, 35mm -> **score = 1**; both glabrous-> **score = 1.**

HYBRID INDEX = 15.2

Tree 8264														
Leafa	2	57	3.5	1	34 43 32 0.04	3	<	reg	3	3	1	1	3	12
b	7	100	7.0	2	55 59 41 0.23	2	>	reg	2	4	1	2	3	12
c	3	68	4.4	1	37 46 36 0.02	3	<	reg	3	3	1	2	3	13

Average leaf score = 12

peduncles 23mm, 28mm -> **score = 2**; pubescent -> **score = 3**

HYBRID INDEX =17.3

	Petiole length (mm)	Total leaf length (mm)	% petiole	Score	W_3	W_2	W_1	$\frac{W_3-W_1}{W_2}$	Score	Lobing > or < 50%	Lobing reg or irreg	Score	Lobe pair no.	Score	Auricle score	Pubescence score	TOTAL
Tree A4																	
Leafa 3	83	3.6	1	37	42	42	-0.1	3	<	irr	2	4	1	1	1	9	
b 5	82	4.9	1	28	38	30	-0.1	3	<	reg	3	3	1	1	1	10	
c 4	90	5.5	1	50	55	40	0.18	2	<	irr	2	4	1	1	1	8	
d 5	96	5.2	1	46	52	37	0.17	2	<	reg	3	3	1	1	1	9	
e 3	96	3.1	1	44	57	44	0.00	3	<	irr	2	4	1	1	1	9	
															Average leaf score =		9.0
peduncle 32mm -> score = 1; glabrous -> score = 1															HYBRID INDEX =		11.0
Tree A5																	
Leafa 7	93	7.5	2	47	48	41	0.12	2	<	reg	3	4	1	1	1	10	
b 8	90	8.8	2	35	46	46	-0.2	3	<	reg	3	4	1	1	1	11	
c 12	92	13.0	3	38	45	34	0.11	2	<	reg	3	3/4	1	1	1	11	
															Average leaf score =		10.7
peduncle 25mm -> score = 2; glabrous -> score = 1															HYBRID INDEX =		13.7
Tree 8289																	
Leafa 5	86	5.8	1	38	44	35	0.07	3	<	irr	2	4	1	2	1	10	
b 5	100	5.0	1	39	38	27	0.31	1	<	reg	3	5	2	2	1	10	
c 4	75	5.0	1	31	35	27	0.11	2	<	reg	3	3	1	2	1	10	
d 7	96	7.3	2	42	44	27	0.34	1	<	reg	3	4	1	2	1	10	
e 5	78	6.4	1	42	37	28	0.38	1	<	reg	3	3	1	2	1	9	
f 4	82	4.8	1	32	34	25	0.21	2	<	irr	2	4	1	1	1	8	
															Average leaf score =		9.5
No acorns																	

(HYBRID INDEX = 9.5 - calculated on 6 characteristics only)
(Equivalent index score = 12.7)

Average Hybrid Index for these 9 trees = 14.0

MINIMUM SCORE ie. theoretical score for **Q.robur** = 8
MAXIMUM SCORE ie. theoretical score for **Q.petraea** = 24
INTERMEDIATE SCORE ie. theoretical hybrid = 16

TABLE 2a - Simple analysis of 34 trees

TREE	Petiole	Shape	Lobing	Lobe no.	Auricles	Leaf hairs	Peduncle length	Peduncle hairs	**HYBRID INDEX**
E	2/3	1	1	1	1	1	1	3	12.5
B	1	1/2	2	1	1	1	1	1	9.5
H	1	1	1/3	1	1	3	1/2	3	13.5
A5	2	1	2/3	1	2	3	-	-	(8.5)
A6	1	1/3	1/2	1	1/2	1	-	-	(8.0)
8242	1	1	2	1	2	2	-	-	(7.0)
8240	2	2	1	1	2	3	1/2	1	13.5
A7	1	1/2	1	1	1	1	1	1	8.5
8290	1	1/3	1/2/3	1	1	1	-	-	(8.0)
A8	1	1	1	2	1	1	2	2	11.0
A9	1	1	1	1	1/2	2/3	2	3	12.0
A10	1	1	2/3	1	2	3	1	1	12.5
A11	1	1	2/3	1	1	1/2	1/2	1	10.5
A12	1	1	2/3	1	1	1/2	1/2	1	10.5
A13	1	2	2	1	2	1	2	3	14.0
A14	1	1	2	2	2	1	2	3	14.0
A15	1	2	1	1	2	3	1	3	13.0
A16	1	2/3	1	1	2	1	1	3	12.5
A17	1	1	1	1	1	3	1	1	10.0
A18	2	2	1	1	2	3	-	-	(9.0)
A19	3	3	1	1	2	1	1	1	13.0
A20	2	3	1	1	2	3	-	-	(12.0)
A21	1	1/2	1/2	1	2/3	2	2	1	13.5
A22	2	2	2	1	2	1	2	1	13.0
A23	2	2	1/2	2	1	3	1	3	15.5
A24	2	1	1	1	2	3	-	-	(9.0)
A25	1	1	3	1	1/2/3	3	3	3	17.0
A26	1	2	2	1	2	3	3	1	13.0
A27	1	1/2/3	1/2	1	2	1	1	1	10.5
A28	1	2/3	2	1	2	1	-	-	(9.5)
8233	1	3	2/3	1	2	1	1	3	14.5
A29	1	1	1	1	2	2	-	-	(7.0)
8280	1	2	2	1	1	1	1	1	10.0
A30	1	1/2	2	1	2	1	1	1	11.5

Average = 12.1

Key: 1 - characteristic of Q.robur
2 - characteristic of Q.petraea
3 - intermediate characteristic

MINIMUM SCORE ie. theoretical score for **Q.robur** = 8
MAXIMUM SCORE ie. theoretical score for **Q.petraea** = 24
INTERMEDIATE SCORE ie. theoretical hybrid = 16

For full explanation of scoring see page ..
(Where different leaves on the tree show characteristics of more than one type more than one score is given for that character.)

TABLE 2b - simple analysis of 17 trees

NB. Method of sampling leaves as specified by Cousens - see page....

TREE	Petiole	Shape	Lobing	Lobe no.	Auricles	Leaf hairs	Peduncle length	Peduncle hairs	**HYBRID INDEX**
A	1	1	2	2	2	1	3	1	13.0
B	1	2	2	2	1	1	1	1	11.0
C	1	1	3	2	2	3	3	1	16.0
D	2	3	2	1	2/3	1	2/3	1	15.0
E	1	1	2/3	2	2	3	2	3	16.5
F	1	1	1	1	1	1	3	1	10.0
G	2	1	3	1	2	1	1	1	12.0
H	1	2	1	1	1	1	3	1	11.0
I	1	1	2	1	1/2	1	3	1	11.5
J	1	3	2	1	1	1	2	1	12.0
K	1	1	1	1	1	3	2	3	13.0
L	1	3	1	1	1	1	-	-	(8.0)
M	1	3	2	1	1	1	3	1	13.0
N	2	1	2	3	1	3	1	3	16.0
O	1	1	2	3	1	1	3	1	13.0
P	1	2	2	1	1	3	3	3	16.0
Q	1	1/2/3	3	2	1	1	2	1	13.0

Average = 13.1

TABLE 3 - simple analysis of "standards"

TREE	Petiole	Shape	Lobing	Lobe no.	Auricles	Leaf hairs	Peduncle length	Peduncle hairs	**HYBRID INDEX**
Q.rob	2/3	2/3	1/2	1	1/2	1	1	1	12.0
Q.rob	1	1	1	1	2	3	1	1	11.0
Q.pet	2/3	2/3	3	3	3	3	3	3	23.0
Q.pet	3	3	2/3	3	3	3	3	3	23.5
x ros.	1	1	2	2	1	3	2/3	3	15.5
x ros.	3	2	1	2	1/2	3	2/3	3	18.0

Key: 1 - characteristic of Q.robur
2 - characteristic of Q.petraea
3 - intermediate characteristic

MINIMUM SCORE ie. theoretical score for **Q.robur** = 8
MAXIMUM SCORE ie. theoretical score for **Q.petraea** = 24
INTERMEDIATE SCORE ie. theoretical hybrid = 16

SUMMARY

In total 60 Cadzow oaks were analysed.

1. Detailed analysis of 9 trees:

Average = 14.0

2a. Simple analysis of 34 trees

Average = 12.1

b. Simple analysis of 17 trees (sampling as per Cousens)

Average = 13.1

OVERALL AVERAGE = 12.7

NB.

MINIMUM SCORE ie. theoretical score for **Q.robur** = 8

MAXIMUM SCORE ie. theoretical score for **Q.petraea** = 24

INTERMEDIATE SCORE ie. theoretical hybrid = 16

DISCUSSION

These trees are not Q.robur for all their characteristics. However they could not be described as Q.petraea. The quantitative analysis which the Hybrid Index calculation allows shows them to be closer in nature to Q.robur than to Q.petraea - the average score for all the trees is 12.7. This is closer to the expected value for Q.robur than the expected value for Q.petraea. Nonetheless, as has been stated already the degree of variability within each of the species is such that it is worth considering whether the calculated result represents a genuine taxonomic difference.

The fact that there is some variablity within each species is borne out by the Hyrid Index score obtained for the "standards". These are slightly different from the theoretical values - 10.0 instead of 8.0 for the standard Q.robur, and 21.5 instead of 24.0 for the standard Q.petraea.

A statistical comparison of the average score for the Cadzow oaks with each of these 2 values showed that there was a significant difference between them and the standard Q.petraea. This was to be expected. However a t-test comparing the standard Q.robur with the Cadzow score showed that there was no significant difference between the 2 samples at a 95% level of probablity. The implication of this is that the variability

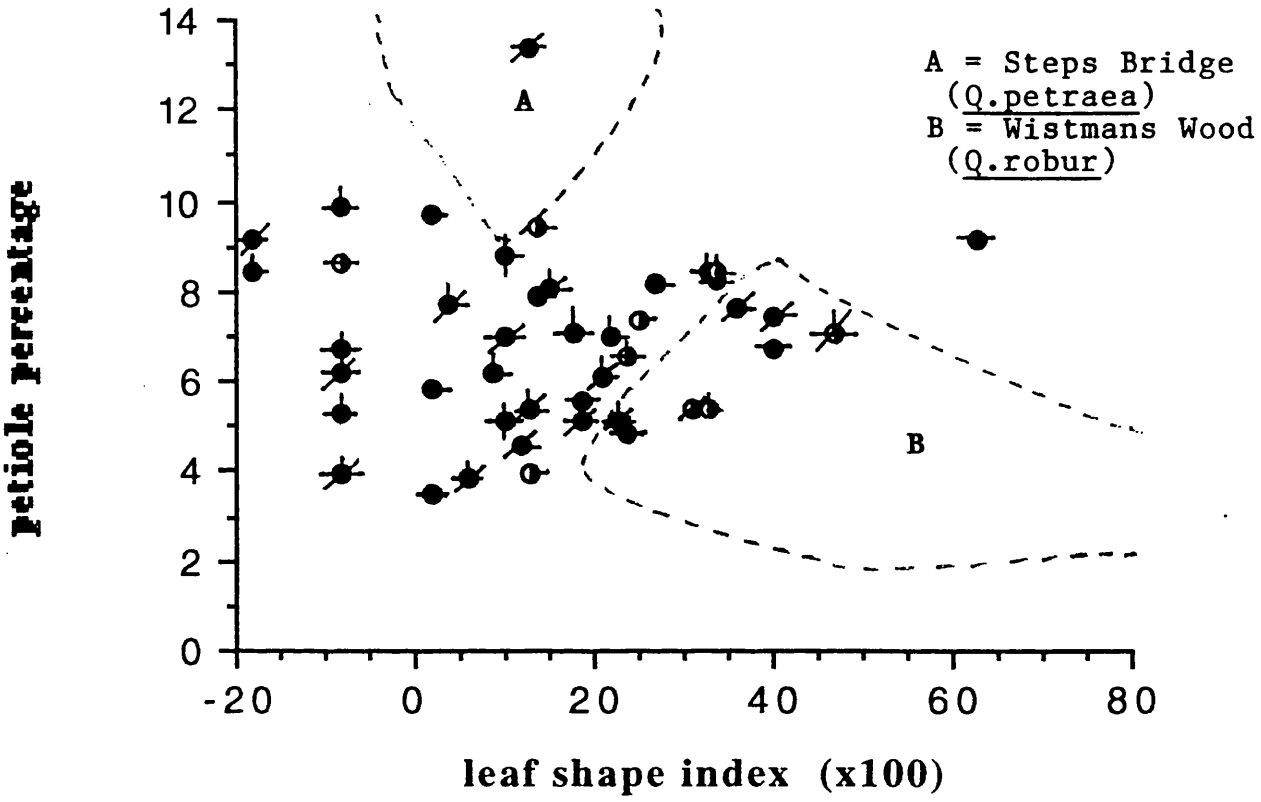
shown is consistent with the normal degree of variabilty within the species and that the trees are not hybrids.

But such statistical tests may be misleading. Careful study of the data shows that non-Q.robur characteristics exist for every one of the features analysed. Most commonly, values of 3 and 2 (representing aff.Q.petraea or intermediate respectively) were found for the nature of the lobing, auricle shape and leaf pubescence. But there was no characteristic for which a score of 3 or a score of 2 could not be found.

Carlisle and Brown (1965) applied the technique of Pictorial Scatter Diagrams (developed by Anderson 1949) to hybrid analysis. This makes use of two continuously variable morphological characteristics which are then plotted against each other. Subsidiary information can then be added, the result being a visual representation of the degree of hybridisation in a population. The Pictorial Scatter Diagram (over) has been constructed for the 44 leaves which were analysed in detail.

Only 2 of the eight characteristics can be quantified - petiole percentage and leaf shape index. The values for these are plotted out for each leaf and the spread of the points gives an indication of the nature of the trees. Further information about the leaf is then conveyed using symbols for

PICTORIAL SCATTER DIAGRAM FOR CADZOW OAKS



Lobing : Aff. Q.robur....
Intermediate....
Aff. Q.petraea..

Lobe Number: Aff. Q.robur....
Intermediate....
Aff. Q.petraea..

Auricles: Aff. Q.robur....
Intermediate....
Aff. Q.petraea..

Pubescence: Aff. Q.robur....
Aff. Q.petraea..

Thus for these 4 charactersitics:

pure Q.robur	intermediate	pure Q.petraea
✳	⊢	o

the plotted points. In order to provide a comparison I have marked onto the diagram the part of the PSD within which two typical populations of oak are found (based on Wigston 1974).

The implications of this diagram are quite clear. The Cadzow oaks are not found in the region one would expect for Q.robur. They are certainly closer to this than to Q.petraea but there is a very strong indication that they are not Q.robur. The fact that they are not simply intermediate for all charactersitics suggests that some introgression has occurred as suggested by Cousens.

Why then did the t-test suggest that no significant difference existed? It is possible that a larger sample of "standards" would give a more accurate picture of the variability within Q.robur. One would expect it to be significantly less than the observed variability of the Cadzow oaks. Alternatively it could simply be, as stated by Rackham, that statistical methods do not lend themselves to this kind of analysis.

CONCLUSION

In summary the Cadzow oaks may be closer to Q.robur than to Q.petraea but they are not pure Q.robur. They are possibly the product of some past hybridisation followed by further introgression with the Q.robur.

Plate 2a
The Cadzow oaks (August 1992). Many of the trees do not have such complete crowns as those above.

Plate 2b
The oldest oak? (>800 years old?)
Girth = 25 feet, crown small.

Plate 3a
A possible pollard. Trunk hollow but branches are alive.

Plate 3b
The area of "run-rig" - trees standing on top of old cultivation.

-3-

INFORMATION FROM HISTORICAL DOCUMENTS

INTRODUCTION

It has already been stated that the Cadzow Oaks exhibit some bizarre shapes. The massive girth of the trunks and their "stagheadedness" may largely be attributable to nothing other than their age. However it has long been suspected that the past management of the trees may be equally implicated ie. that they were pollarded. If the strange habits of the trees have been caused by their past management then historical documents may record this.

This research is primarily a botanical study of the oak trees and so the value of studying these documents should be seen in this context. The information obtained from them should corroborate the conclusions drawn from a study of the actual trees. Indeed, other than in exceptional circumstances, a study of both will always be required. Historical documents are not totally accurate (as will be shown - see page 62) and in any case were rarely written to provide botanical information. Therefore facts relevant to this research may

only have been presented by the authors of the documents in an incidental fashion.

1. STATISTICAL ACCOUNT OF SCOTLAND (1791-1799)

The author of the account for the parish of Hamilton (John Naismith) in which these oaks are found not only knew of these trees but gives quite a full description of them:

> "The old oaks in the Duke of Hamilton's park, have always been regarded as a curiosity. They have, no doubt, been very majestic trees, some of them measuring upwards of 27 feet round. They stood irregularly at a distance from one another, covering a considerable extent of pretty plain ground; and seem to be the last remains of those antient forests, which, in former times, overspread the country. They have been much diminished in point of number, in the course of the present century; many of them having been cut down, many having fallen down, and many of those that remain, having lost their tops and fine spreading boughs, are now only mutilated trunks, covered with short scrubby branches, still exhibiting the melancholy remains of their former grandeur. Among these venerable trees, grazed the wild cows, mentioned by naturalists as an untamed native breed."

Unfortunately he does not provide us with a detailed description of how the trees were managed, if they were managed at all. It is surely significant that even at this time he should say that these trees have always been regarded as a curiosity. Then, as now, they were striking because of their size and because of their shape. Indeed his description could well be applied to the trees standing today. His explanation of these features is simple: that these trees were the remains of the original forest which covered the whole of that area. No evidence is given to support his claim and later documents suggest an alternative origin of these trees (see page 38).

Changes to the trees within living memory are recorded - that they have either been cut down or have simply fallen down. The falling down of the trees might suggest that they were of a great age for it is known that some of the recently fallen trees were over 400 years old (Baillie 1982) (see page 65). Unfortunately no explanation as to why trees were cut down is provided although the estate records (see page 42) do provide some information on this.

As already stated, it is suspected by some that the trees were pollarded repeatedly. However there is no mention of pollarding here. The absence of any such references does not *per se* imply that they were not being pollarded - they may well have been but this is simply not recorded. Surely if tree

pollarding were occurring regularly or on a large scale, as is the general belief, then one could expect some mention of it.

The age of the trees could explain the absence of such a reference. It has been shown that some of the trees, quite recently fallen, began their lives before 1500 (the oldest stump dating from 1444) and some may be older than this. These trees could thus have experienced pollarding during the 15th, 16th, 17th or even the 18th centuries and yet the author, writing in the late 18th century, may have known nothing of this. Unfortunately, as will be seen, very little information is available for the period prior to the writing of this account.

2. NEW STATISTICAL ACCOUNT OF SCOTLAND (1845)

The author of the Hamilton parish record some 50 years later seems to have had a definite interest in natural history but mainly that which concerned the animals of the area. He spends no fewer than 5 pages listing the interesting fauna of the area but unfortunately has little to say regarding its flora (only two paragraphs). Nonetheless he does later mention the old oaks and even provides some description of them:

"The Old Oaks behind Cadzow castle cover several hundred acres and are evidently of great antiquity. (Some of these are English oaks, supposed to have been planted by King David, first Earl of Huntingdon, about the year 1140.) Many of the trees have attained an enormous size, measuring 36 feet in circumference. One near Wood House, called the "boss tree" is capable of containing at one time eight individuals of the ordinary size. The chase in which these venerable combaters of time are now vegetating is browsed by about four-score white cows of the ancient British breed."

In addition to a description of the trees the area covered by them is also mentioned. His claim of "several hundred acres" is significant as the present area is quite considerably less - the actual trees only cover an area of approximately 18 hectares (roughly 45 acres). Another figure comes from a reference to the park in 1853 - that it covered an area of about 1400 acres (Dawson 1853). The accuracy of this is questionable - the Ordnance Survey map of 1858 (see page 62) shows the area of the park as 760 acres, although it is not all wooded.

There is still no mention of any management of the trees, eg pollarding. As with the OSAS this might imply that there was no active management at the time although the other possibility - that it was simply not recorded - cannot be

discounted. His interest focuses on their size and antiquity. His claim that they were planted by King David I is by no means unusual - some local people today are still of the opinion that the trees are eight or nine hundred years old. This theory contradicts that put forward in the OSAS ie. that these trees represent the vestiges of the primaeval forest of Scotland.

One wonders what the author meant when he describes them as "English oaks" - simply that they were planted by an Englishman, or was the difference between the 2 native British species (Quercus robur) and (Quercus petraea) appreciated? As already stated the taxonomy of the oaks is a very confused issue. The early floras of the Clyde area reveal considerable ignorance amongst the local naturalists. Hopkirk (1813) describes only 1 species (Q.robur), which he says is common. Later Hennedy (1891) describes 2 separate taxa although they are classified as Q.robur and Q.robur var.sessiliflora. There is still a lack of understanding however - Lee in 1933 describes 2 species which very obviously correspond to the present Q.robur and Q.petraea. However he states that it is the latter (still referred to as Q.robur var.sessiliflora) which is the non-native one (Lee 1933, page 99):

> "The variety, which is by some regarded as a distinct species, occurs as a planted tree in some places, scarcely wild."

Modern taxonomic thought states that Q.petraea is the characteristic tree of Scotland eg. Jones (1968); Clapham,

Tutin and Moore (1987) although Q.robur does now occur very widely. This description of the trees as "English Oaks" in the NSAS of 1845 would surely not be a clear indication of the trees being identified as Q.robur as opposed to Q.petraea. It is likely that this is said as the trees were thought to have been planted as acorns imported from England.

Genuine familiarity with the area is suggested by the descriptions of the white cattle which were found among the trees:

> "they (the cattle) are perfectly docile, except when they have calves. On these occasions they manifest an uncommon attachment to their young, by carefully concealing them when they are dropt, and defending them when attacked."

The element of detail (if genuine and not simply passed on) might imply that he had a first-hand experience of the area, thus adding credibility to all his observations. It is of primary importance to establish whether or not the information can indeed be trusted as accurate. Details such as these mentioned above (although not necessarily botanical in nature) may prove significant in judging the account's authenticity.

However caution must be exercised since there are other indications that these documents contain some anomalies. The first Statistical Account states that the cattle "were

exterminated, from economical motives about the year 1760". The significance of this is that the later Account (1845) and other texts (eg, labourer's accounts 1801- 1802) make it clear that the cattle **were** present in large numbers in the park. It is of course possible that there was a short period during which the cattle were absent, prior to reintroduction, and this would explain the discrepancy.

3. THE THIRD STATISTICAL ACCOUNT OF SCOTLAND (1960)

In this recent account of the parish of Hamilton there is no new information relating to the Cadzow oaks. Mention is made of them but only in the context of the area being a favourite place for artists, the unusual appearance of the trees presumably continuing to provoke interest.

4. MANUSCRIPT MATERIAL OF THE DUKE OF HAMILTON'S ESTATE

(NB. An exhaustive study of the estate records has not been undertaken but much useful information has been taken from transcripts of the original documents which are held at Chatelherault Country Park. A brief survey was made of the material held in Hamilton District Library. However the collection is extensive and it has proved unfeasible within the time constraints of this project to conduct a full survey of the estate records.)

The Cadzow Oaks

The daily records of life on the Hamilton estate often refer to the "old oaks" and so distinguish them from other oaks on the estate by consistently referring to them as such.

It is evident from these records that the trees were seen as a valuable asset and there are several accounts of the enclosure around them being repaired. In 1736 (Hutton 1736) and on several other occasions eg. Wright (1740), Labourer's Account (1801), Burrell (1801) this is specifically described. The first of these mentions the use of timber from some damaged oaks, cut down during the previous two years, to repair the enclosure. As there was not sufficient wood from these damaged trees to repair the wall, permission was sought to take some more from "the most useless of the old oaks yet standing rather as consume timber that will give 15d or 18d per foot" (presumably other trees in the grounds).

Obvious attempts are being made to maintain the enclosure around the old oaks but why should so much time and effort be spent on this? Was it to protect the trees, perhaps because of their value as timber? Grazing animals would rarely damage mature trees and so this seems unlikely. Generally trees are vulnerable when they are very small and establishing themselves. Therefore the exclusion of animals could have been to encourage regeneration. This was a standard practice in areas of coppicewood following the felling of the trees (Rackham 1980).

Alternatively if, as suggested, pollarding was being practised on these trees would this protection have been necessary? Pollarding is a much more difficult and time consuming method of producing timber (Rackham 1980) and its raison d'etre was specifically to allow new growth of wood in the presence of grazing animals (since the young shoots would be out of their reach). It seems unlikely then that the enclosure would have been maintained to exclude grazing animals.

The explanation is surely that the enclosure was being maintained to keep the animals of the hunt inside rather than to keep grazing animals outside. Indeed the Estate Accounts refer to the "dyke of the chace" (Hutton 1736), a chase being a private Forest (Rackham 1989) - an area in which deer (or other animals) were protected. This does not of course preclude the possibility of pollarding being practised as well but it would suggest that the main reason that the wall was being maintained was to preserve the chase.

The accounts of 1797 (Burrell 1797) show that the trees themselves were valued. It is recorded that the area of the old oaks was offered for rent, however part of the agreement was:

> "That we shall be debarred from damaging any of the growing Trees upon the grounds and Shall have no Right to plow within five yards of the trunks thereof."

This suggests that the trees were valued for their timber rather than as an integral part of the chase. If the area's prime importance was as a chase then ploughing would hardly have been allowed to occur as this would have been incompatible with the hunting of cattle. So was it indeed ploughed? It may well have been temporarily (see Plate 3b) but later records eg, NSAS suggest that the area was still maintained as a chase.

Some of the trees were undoubtedly used for their timber. In 1736 Robert McLean, "a kiper in Urvine" is taken "to see the old oaks cutt att in knees, he seems very well pleased with that kind of ship timber" (Hutton 1736). As the wood is obviously being inspected with regard to its use in the shipbuilding industry it seem reasonable to conclude that "cut att in knees" is referring to the knees of a boat. Jones (1974) states that the "knees" in a British man-of-war were made entirely from the naturally curved boughs of widely spaced oak trees. This use of "knees" is also adopted by Linnard (1982). To produce ship's timber the normal practice would be to allow a large trunk to grow so that this could be sold as timber. Cutting the trees (either coppicing or pollarding) is more suited to providing smaller wood suitable for firewood etc (Rackham 1980). This may imply an absence of pollarding - trees which had been pollarded (or coppiced) would surely not have been so suitable as ship's timber.

Confirmation that the trees were being cut down and sold comes from the complaining words of a Glasgow merchant :

> "If any knew the Excellent Oak Woods that are in Scotland, particularly in his Grace the Duke of Hamilton's Park..... and how there they are cut down and carried away to Ireland, and some to Scotland, that by degrees they will be wasted, whereas if preserved, might serve to help us build Vessels, at home, as some have been at Glasgow, with help of some plank from Dantzick" (Spruel, 1705 although this source of reference unclear - see page 52).

A reference from 1764 (Burrell 1763-69) confirms that the estate was in fact selling timber on a large scale although it was not only oak that was being sold. There are numerous references to other species eg plane, ash, beech and to oaks (as opposed to "old oaks") from various nearby sites eg Edelwood, Laverock hill. The last of these was an area of "Haggs" which Naismith (1798) describes as being areas of coppicewood. Nonetheless some of the trees sold were undoubtedly the old oaks (Burrell 1796) although it would appear that this was not on a large scale.

Oak bark was also a source of income for the estate. Tree bark, particularly of the two native oak species, is a good source of natural tannins and these were widely used when tanning leather, ie. turning raw hides into leather (Linnard

1982). Most of the tannin lies in the inner layers of the bark hence relatively young wood provides more tannin. Jones (1968) states that, in a coppice wood, the harvesting would occur every 15 years (or every 20 or 21 years for charcoal production as well). This maximised the amount of useful bark obtained. In contrast the rotation would be longer than this if the intention was to produce wood - harvesting every 30 years.

If the old oaks were pollarded then the oak bark mentioned could have been coming from them. However there is no indication that this is the source of the bark. When the oak bark is mentioned in 1776 it is in connection with "the weedings of the Back muir" (later described as a plantation - Burrell 1796) or, later, "brushwood". Weedings would probably be connected with thinning operations either in planted wood or even in naturally regenerating wood. Certainly it would not seem a suitable description of branches lopped off the old oaks. Similarly with "brushwood" - possibly the regrowth after coppicing but surely not the old oaks. The brushwood was in another instance used for filling drains (Burrell 1801)

Throughout the accounts there does seem to be great attention to detail. In all cases the trees used are described, as well as specific descriptions of what they were used for. In 1789, for example, there is an account of "2 days of 3 men cutting and peeling oak trees, cut down in the Laverockhill for rollers". If such detailed accounts are so

frequent then surely there would be some surviving record of the old oaks being pollarded, if indeed they were.

An alternative use of wood (as opposed to timber) is also described (Ray, 1790):

> "grubbing out 328 small trees in the Gallowhill and Deer park which were made into Charcoal for the use of Hamilton House at 3d each."

This itself would not affect the old oaks except there is the possibility that since a kiln was prepared at the Old Oaks to provide charcoal for Hamilton House (Burrell 1799-1800) some of the old oaks might have been cut down or had branches lopped off to fuel it. Whether or not it was these actual trees or those round about which were used is not recorded but it seems possible that at least some of the trees would have been affected.

5. OTHER HISTORICAL INFORMATION

It seems beyond doubt that there has indeed been an area of woodland where the present oaks now stand for a long period of time. Early maps (see page 107) clearly show woodland there. Anderson (1967) cites the following account of land being bestowed on the abbey of Kelso (by Robert de Kundres) as evidence of there being woodland at Cadzow from the time of writing (1222) onwards:

> "beginning at the oak tree marked with a cross, standing at the head of the syke, and descending along that syke to the march burn and by it into the Clyde, and on the other side, from the same oak, going along it to the Clyde opposite the land of Thomas FitzThancard; with common pasture of Wood of Roshauan for ten cows and ten oxen."

However this is hardly evidence of there being woodland there at the time since only individual trees are mentioned. Indeed one could even use this as evidence of an absence of woodland there - if individual trees are recognisable then they cannot have been totally surrounded by others. Conclusions from this document must be considered highly conjectural.

Some 200 years later there seem to be several references to the area in connection with its trees. According to Anderson (1967) the formation of the park seems to have occurred around the year 1445 (but see page 52). The first

full description of the area is from 1667 (more than 130 years prior to the OSAS) and the removal of trees is already significant. Sir John Lauder, visiting Hamilton park says (Crawford 1900, page 186):

> "Then went to the wood, which is of a vast bounds, much wood of it is felled; their being great oakes in it yet; rode through the lenth of it, it is thought to be 5 miles about."

In 1695 Gibson says:

> "The Park (famous for its tall oaks) is six or seven miles round, and has the Brook Aven running through it."

If this is more than a passing remark ie. if the adjective "tall" was purposefully chosen, then this suggests there was no pollarding. A shredded tree would fit this description but a pollarded tree would not, and neither would trees which were coppiced regularly. Anderson states that Sir Robert Sibbald visited Hamilton Park in 1668 and that it was then famous for its "tall oaks". This is perhaps from the same source as above although I have been unable to locate his source of reference (see page 52).

The next significant descriptions found are by John Naismith, presumably the same John Naismith as the author of the account in the OSAS mentioned on page 36. The description found in his own book is very similar to the one in the OSAS. (Naismith 1798)

The significance of the two reports from the 1660s, if correct, is twofold. The description of the trees as "tall" would not be compatible with pollarding, or indeed with the ancient oaks as found now. Spruel's description of the harvesting of the trees for ship's timber does not suggest pollarding (ie this produces smaller pieces of wood). It is of course possible that pollarding was occurring in the area of the old oaks and not elsewhere on the estate but there is no suggestion of pollarding here.

CONCLUSIONS

The historical record does not provide unequivocal proof that pollarding either was, or was not, being carried out on these trees. Nonetheless the clear implication is that this type of management was not being practised on them. Some record of pollarding would surely exist today - numerous other uses of the trees are widely recorded. In addition such descriptions of the trees as there are do not seem compatible with the practice of pollarding.

These historical documents may thus provide some clues to the past but a more definitive answer must be sought elsewhere. Herein lies the value of studying the trees themselves. Each tree carries within it a record of its life - in its shape and in the pattern of its annual rings. It is the task of the

botanist to interpret this information and so unravel the history of the trees.

* Several of the references form Anderson (1967) have proved impossible to verify. His quotation from Sibbald is said to come from:
Mitchell,A. (1907) Sir Robert Sibbald's Geographical Collections. Scot Hist. Soc.
However the British Library and Cambridge University Library state that such a book of Sir Robert Sibbald's travels edited by A. Mitchell does not exist.

Spruel's document of (1705) is cited as follows:
Spruel,J. (1705), An accompt current betwixt Scotland and England ballanced. Edinburgh
This article has been checked and, while he undoubtedly complains about the export of numerous products, timber and the trees at Hamilton are not mentioned.

A further discrepancy has presented itself. On page 235 Anderson implies that a park was created at Cadzow when James 1st Lord of Roslin acquired it. This could be highly significant - the oldest dated tree stump is from 1444 and one could speculate as to whether the coinciding of the two dates were in some way linked. This could be the case if the formation of the park occurred through the planting of trees. Alternatively the trees may already have been present but simply became enclosed. Unfortunately Anderson's source of reference is unclear - it is possibly The Accounts of the Great Chamberlains of Scotland 1326 - 1453 Ed T. Thomson 1817 - 45. These accounts have been checked and no record of this can be found. Interpretation of his statement must therefore be restricted.

-4-

INFORMATION FROM OLD MAPS

Studying early maps can provide a wealth of information about the history of an area. At the simplest level a map can show whether or not a wood was present there at the time the map was drawn. Detailed maps can also show the shape of a wood, how far it extended and the nature of enclosing boundaries.

As with any old document, great care must be exercised in its interpretation. Maps or documents which corroborate each other are invaluable, especially if they can be shown to have been independently produced ie. as opposed to one being based on the other.

Photocopies of some of the early maps of the Cadzow area are included.

The study of each map was undertaken in the following manner. Initially some attempt was made to gauge the general level of accuracy of the map. Thereafter each of the following points was considered

1) Is there any indication of trees growing in the area in question?

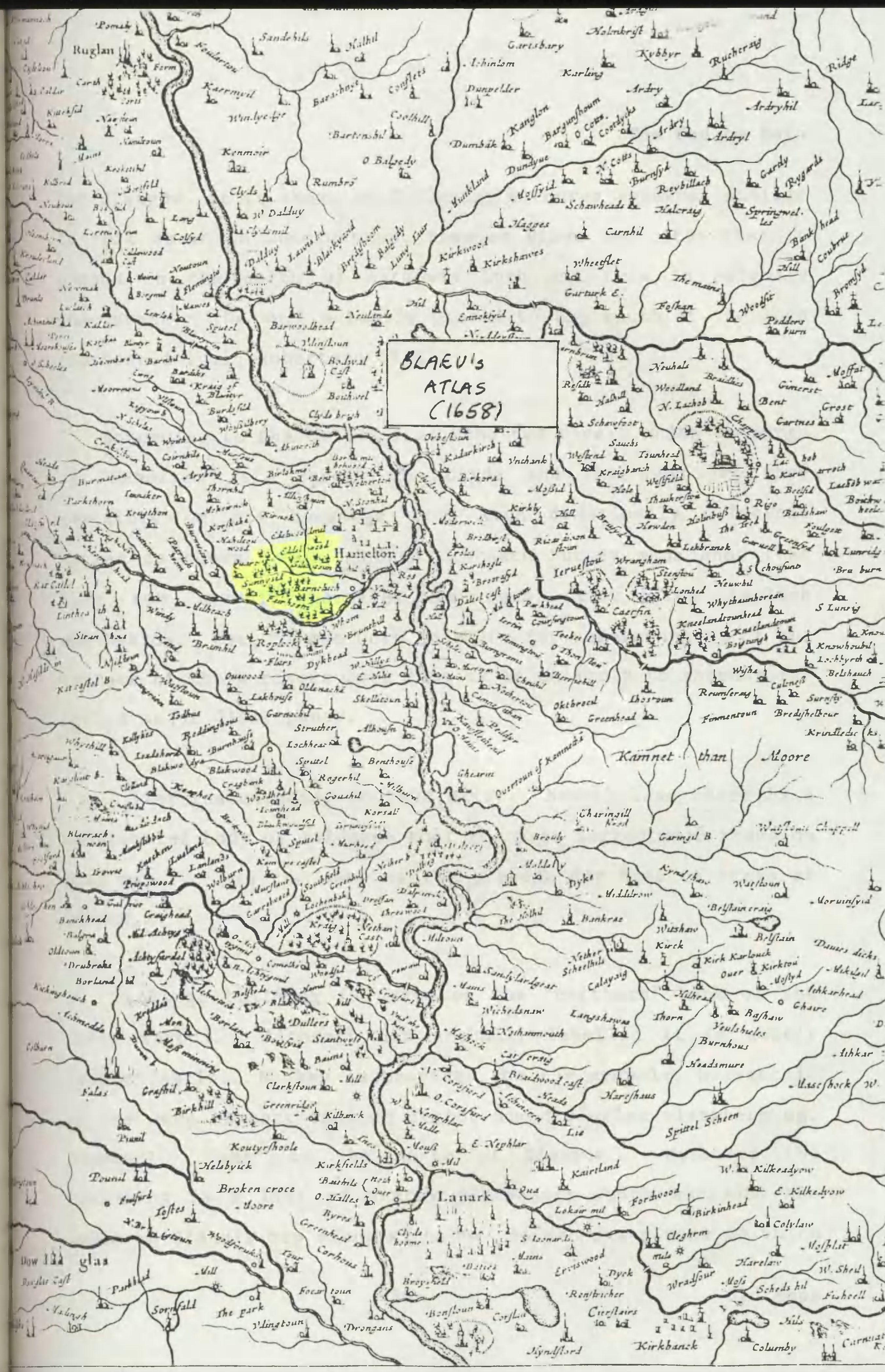
2) If trees are in the general area can their exact location and extent be identified by using surrounding placenames, physical landmarks such as rivers, etc?

3) Having pinpointed the precise area and the trees growing there what information can be gleaned about the extent of the trees and their management?

BLAEU'S ATLAS (see over)

The earliest map found which covers this area is in Blaeu's Atlas Novus of the 17th Century (Blaeu 1654). The 47 maps covering Scotland are based on the manuscript field documents of Timothy Pont, his surveying of Scotland probably occurring between 1583 and 1601 (Royal Scottish Geographical Society, 1973). The relevant map, The Nether Warde of Clydsdail, and Baronie of Glasco - is the only one based on a dated Pont manuscript (1596) and further this is one of the most intensively detailed maps in the atlas (Stone 1991).

Inaccuracies undoubtedly exist in Blaeu's maps. This is aptly demonstrated by his depiction of the Antonine Wall in another of the maps - The province of Lennox, called the Shyre of Dun-Britton. The wall is clearly marked on the maps, although not labelled as such, passing to the north of present


BLAEU's ATLAS (1658)
Ruglan
Hamelton
Lanark
Kamnet than Moore
Broken croce Moore
Kirkwood
Kirkshawes
Barwoodhead
Bodwel Cast
Bothwel
Clyde brigh
Caerfin
Wranghan
Ierueston
Dykhead
Struther
Lochhead
Blakwood
Roger hil
Spittel
Nethan Cast
Craighead
Dullers
Stanthwell
Clerkstoun
Kilbanck
Koutyrshoole
Helebyick
Kirkfields
Carnwath
Cleghorn
Kirkbanck
Columby
Drongans
The Park
Sornfall
Crosford
Braidwood cast
Spittel Scheen
Kirk Karlouck
Lee
Harelaw
Birkinhead
Foswood

day Glasgow. It is shown as following a course somewhat similar to that shown on modern maps, however Blaeu indicates that it passes to the north of Bardowie Loch and this is patently inaccurate - the wall actually passes to the south of the loch (MacDonald 1911, Robertson 1990).

Returning to the Cadzow area, the two rivers which converge at "Hamelton" are surely the Clyde and the Avon yet they certainly do not converge from such drastically different angles as shown here. Modern Ordnance Survey maps show that they run broadly parallel to each other from Raploch northwards. Even if one were to allow for some changing of the courses of these rivers over time it is unlikely to account for such a major discrepancy.

Some inaccuracies do thus exist. Nonetheless there is a substantial body of evidence that the area marked with trees on this map is the same as the present day area of trees at Cadzow.

A large building is drawn on the "northern" bank of the river (Avon). Although not actually labelled it is surely Cadzow Castle. No key is provided for the symbols, however it is the same as that used to depict named castles elsewhere eg. "Mugdack Cast" to the north of Glasgow. Moreover the following is a list of nearby placenames which surround the trees on Blaeu's map along with the modern-day places to which

they seem to relate (based on modern Ordnance Survey 1:50000 and 1:25000 sheets)

"Fairhoom" - **Fairholm** is a farm c.3km up the River Avon.

"Sunnysid" - **Sunnyside** is also up the R.Avon, close to Fairholm.

"Barncluth" - modern maps show **Barncluith** close to the modern town of Hamilton.

"Quart" - **Quarter** appears twice on modern maps, c.2 km south of Cadzow castle, and 1 - 2 km to the East of the R. Avon.

All of these named places surround the trees as they are now. A smaller river is shown flowing into the Avon to the North of the the Castle and this surely corresponds to the Meikle Burn. A name which features on the far side of this burn "Eddelwood" is readily identifiable as the modern **Eddlewood**, now part of the town of Hamilton. The trees are shown as continuing on the other side of this burn, extending as far as "Eddelwood".

It is clear then that the "wood" marked is the same one as is present now, if somewhat greater in extent (see below)

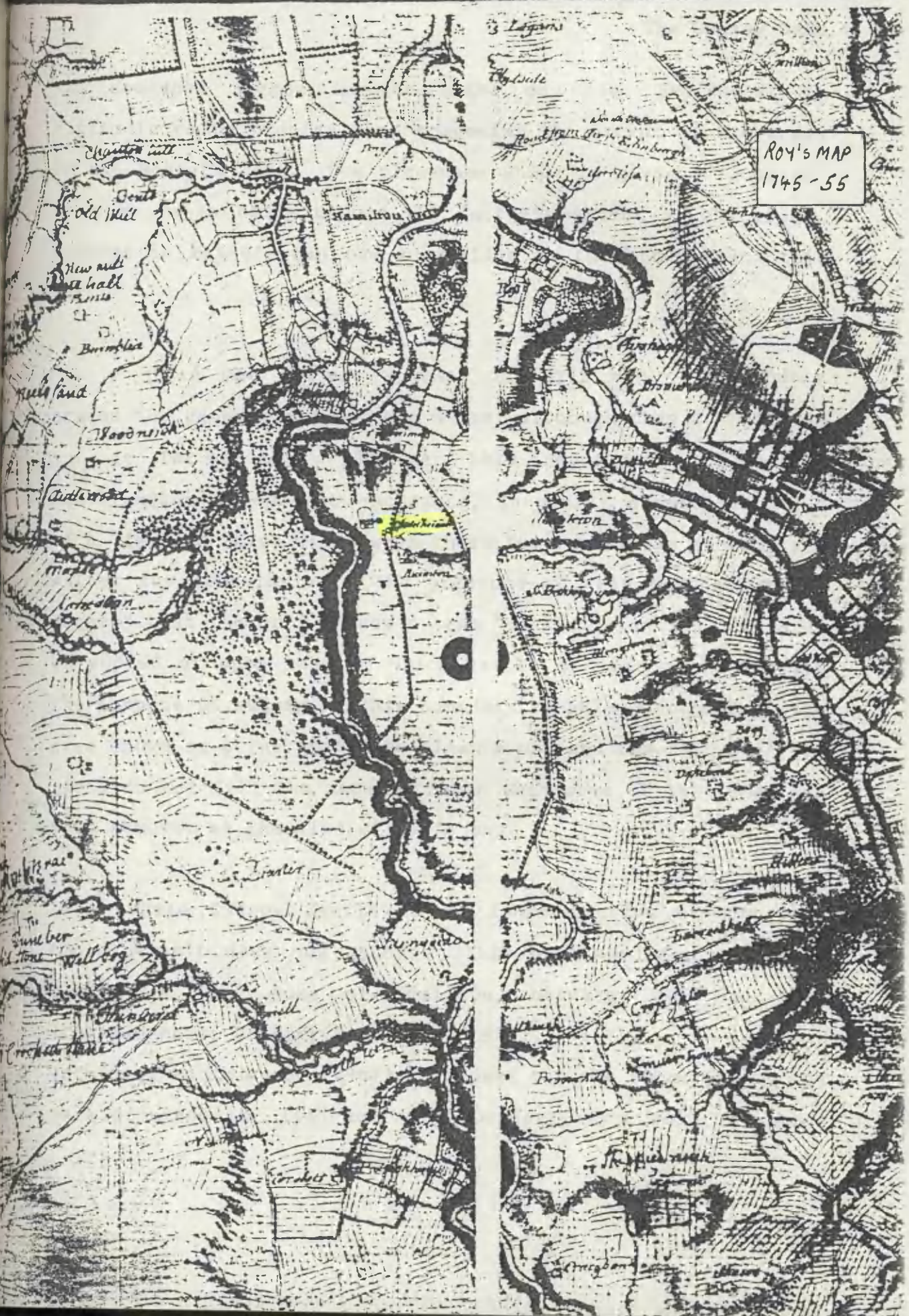
These trees are quite a prominent feature of the map. Other areas are shown as being wooded eg. at "Kraig Nethan Cast" (**Craignethan Castle**) and at "Ruglan" (**Rutherglen**) but the landscape is largely treeless and the areas of trees which are shown on this and many other maps are always less extensive than at Cadzow.

Indeed the extent of the woodland at Cadzow is of no small significance. By and large it corresponds to the furthest extents of the park as shown on later maps. It is significant that it is shown as being on the far side of the Meikle Burn (where, with one possible exception - see page 64) there are no longer any ancient oaks. Moreover the trees also extend across the Avon as far as a clearly marked boundary. No remnants of this area of woodland on the far side of the river can be found today.

THE MILITARY SURVEY OF SCOTLAND, 1745-1755 (over)

The next significant map (chronologically) is that of General Roy from the mid 18th Century (The Military Survey of Scotland 1745 - 1755). Even the most cursory glance shows that this map is much more similar to present day maps. This is not only in the depiction of the trees but also in its depiction of roads, boundaries etc. Blaeu's atlas dates from the age of decorative cartography (Stone 1991) and his symbols are not always entirely clear in meaning. Roy's map is also more accurate in the orientation of the rivers Clyde and Avon relative to each other.

The trees are not shown as covering such a large area as in Blaeu's map - in particular there is no indication that they extend across the Avon to its Eastern side. Since placenames


ROY's MAP
1745 - 55

are somewhat sparse in the later map (ie. Roy's) it is difficult to be precise when comparing the extent of the trees on the Western side. One placename which is given - "Quarter" - is shown as being beyond the furthest extent of the trees, whereas in Blaeu's map the suggestion is that they reach this far.

A quite new feature appears on Roy's map - a boundary around the general area of the trees, although they do not grow out as far as it. Whether this represents the actual construction of such an enclosure, or simply a representation of a feature which was always there but not always shown, is a matter for speculation. The presence of this boundary would suggest that the area is now a true "park" ie. an enclosed area of wooded or open land in which cattle or deer were kept for the purpose of hunting. This boundary roughly encompasses the area shown as being wooded on Blaeu's map and the fact that the trees do not fill the area may mean that some of the trees had been removed by the time of Roy's map.

While Cadzow Castle is no longer marked on the map, Chatelherault does now appear. This hunting lodge was built for James, 5th Duke of Hamilton, between 1732 and 1740 (Chatelherault Country Park guide 1988).
According to Anderson (1967) (see page 64) the formation of the park occurred in 1445 and so a boundary might well have been

present at the time of Blaeu's map even though it has not been shown.

On studying the way the actual trees are shown three main features emerge :

1. The trees are not all drawn in the same fashion. Approximately half of the trees shown have been depicted with a large symbol, while the rest have been drawn much smaller. The significance of this is unclear. Do the large symbols represent large and ancient oaks forming a stand to the south of an area of "ordinary" woodland, as depicted by the smaller symbols? The distribution of these larger trees certainly corresponds to the present-day distribution of ancient oaks. Nowhere else in this region, or in fact on the whole map are trees drawn using a large symbol like this and it is tempting to conclude that this is because nowhere else were such remarkable trees to be found.

If this interpretation of the symbols is accepted as valid then it shows that even at this early date the ancient oaks were restricted in their extent, and there is certainly nothing to suggest that they extended right out to the boundaries of the park. The fact that only one type of tree symbol is shown on Blaeu's map does not necessarily imply that all the trees were of the one type then (eg. all large and ancient). As already stated Blaeu's use of symbols may be slightly

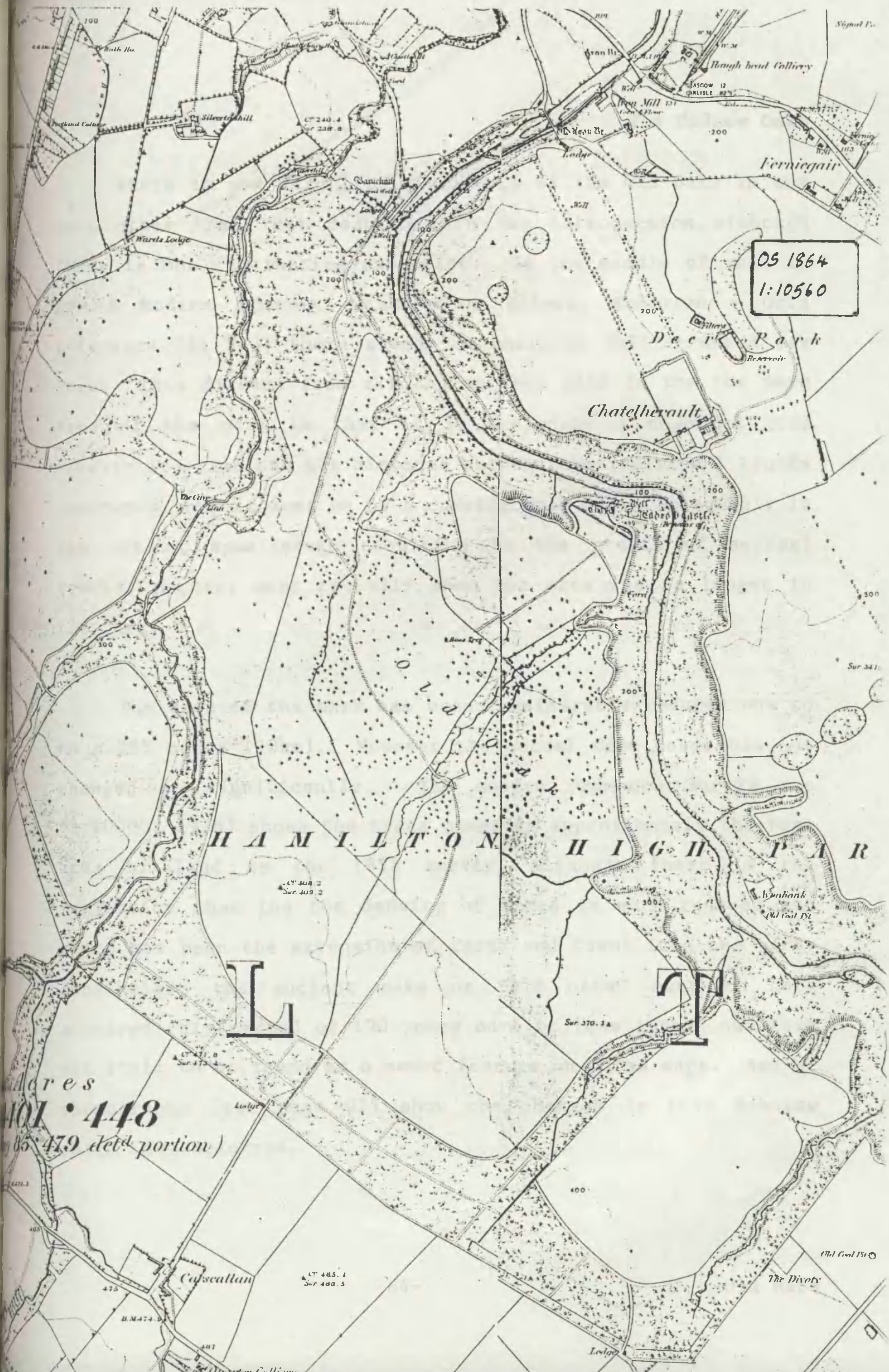
imprecise, and in any case different types of tree may have already been present but simply not noticed.

2. The trees are shown as being bisected by two large avenues, one running roughly parallel to the river, and one cutting across this. These clearly correspond to the "visdas thorow the old wood" described by Alexander Edward (1708).

3. The more prominent of the two avenues is shown as skirting round one large tree, standing proudly in its centre. This may represent the "boss tree" - a particularly large and famous tree described in NSAS of 1845 (see page 38) and shown in a later Ordnance survey map (see below).

ORDNANCE SURVEY MAPS

The First Series Ordnance Survey maps were produced almost exactly 100 years after Roy's map - the surveying for the First Edition 6 inch:1 mile occurring in 1858. Relatively little difference exists between this map and Roy's in terms of the area of the park and how much of it was wooded. In places the trees do appear to be reduced in extent, notably to the south. Dawson (1853) states that the park covered about 1400 acres although the area of park marked on this map (from 1858) is only c.760 acres. The latter is surely the more accurate.


OS 1864
1:10560
Chatelherault
Deer Park
Reservoir
Ferniegair
Cadzow Castle
Old Oaks
HAMILTON HIGH PARK
LT
Acres
401·448
Cadscallan
The Divety
Old Coal Pit
Lodge

The Cadzow Oaks

There is now very little evidence of the Old Oaks in any area other than that described in the introduction although there is one fascinating exception. In the middle of what is now a modern housing estate (Low Waters, Hamilton - Grid Reference 724 523) there stands an enormous multi-trunked oak tree. This differs from all the ancient oaks in the the main area of the park in that it is obviously a **coppiced** tree, however its size and the distance between the individual trunks indicates that it must be of a considerable age. Presumably it was cut at some stage resulting in the growth of several trunks, perhaps most recently when the area was no longer in the park.

The area of the park has been considerably reduced now to to c.225 acres (90ha). However the actual tree cover has not changed so significantly. The modern Ordnance Survey map (1:10000, 1978) shows the trees covering approximately the same area of land as the 1858 survey, although there is the suggestion that the the density of trees is much reduced and there has been the extension of farms and towns into the park. Nonetheless the ancient oaks or "old oaks" seem to have survived this period of 100 years more or less intact and they are still to be found as a named feature on these maps. Aerial photographs (see page 92) show the changes in tree density which have occurred.

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INFORMATION FROM RINGWIDTH MEASUREMENTS

INTRODUCTION

As already stated the Cadzow oaks may have been managed in the past by a system of pollarding. If so, a record of this will exist in the annual rings of the trees. The annual rings are produced by the periodic activity of the vascular cambium. Within a year's growth the larger vessels which are produced in spring contrast visibly with the smaller vessels produced in the autumn. Hence a simple record of the age of the tree is produced.

Moreover this record is qualitative as well as being quantitative. The width of the annual ring reflects the overall amount of growth of the tree during that year. This growth is dependent on a host of factors, environmental changes causing wide fluctuations in the widths of the annual rings. Care must therefore be taken when attempting to account for individual differences between rings in one tree. However if the sample of trees is large patterns in the relative ringwidths will often emerge amongst trees from one locality. Dendrochronologists have used this information to produce master sequences or chronologies which allow samples of wood of

unknown origin to be dated precisely. Much detailed analysis has been carried out on wood from living and dead specimens of bristlecone pine (Pinus aristata) from the White Mountains, California, and this has allowed a master chronology spanning 8200 years to be produced (Raven, Evert and Curtis 1981).

Further analysis of a dated specimen allows other information to be deduced. As stated the width of the annual ring reflects the amount of growth during that year and this may be dependent on climatic factors. Poor climatic conditions or any other factor that negatively affects the overall performance of the tree will result in a "damage cycle" discernible in the annual rings ie. narrower annual rings are produced (Rackham 1975). Such a damage cycle is described by Rackham for Hayley Wood, Cambs. where plagues of the tortrix-moth caterpillar (Tortrix viridiana L.) practically stopped the growth of the oaks trees there. For a ten year period from 1916 onwards the average overall increase in girth was only 1¼cm.

The opposite effect can also be detected. In the same study Rackham (1975) states that the felling of neighbouring trees, or some other beneficial environmental change, can result in "release cycles" in a particular tree. In this case the annual rings are then considerably wider than normal.

If a tree is pollarded then this should be discernible in

much the same way as described above for the defoliating effects of caterpillars. Rackham describes this in some large oak trees growing in Hatfield Forest, Essex (Rackham 1989). Describing what results from a history of repeated pollarding he states (page 247):

> "A section of the bolling therefore shows a sequence of sudden drops in ringwidth followed by gradual increases."

Trees beginning their lives in the mid 17th Century were pollarded 6 or 7 times during their lives, at intervals of 11-36 years. A similar decrease in ringwidth is described by Rasmussen (1990) in ash trees. Experimentally pollarded trees showed a 58% decrease in ringwidth compared with a 5% drop in controls. Graphs which show changing ringwidths over a period of time make this pollarding highly apparent (page 78).

Goodburn (1994), working with timber recovered from waterlogged archaeological sites in London has analysed tree-ring sequences for evidence of pollarding and shredding and combined this with direct analysis of the timber samples.

THE CADZOW OAKS

Some measurement of the annual rings of the Cadzow Oaks has already been carried out. During the mid-1970s and then again during the 1980s Dr MGL Baillie of Queen's University, Belfast, collected samples of timber from the Cadzow oaks - both as sections from stumps of dead trees and also as cores from some

of the living trees. Ringwidth measurements were to be made, his purpose being to construct a master chronology of the type described above. Samples were removed and taken to the dendrochronology laboratories in Belfast where they were analysed. The samples were prepared by polishing and then highlighting the rings with chalk. Measurements were then made to 0.05mm using a travelling binocular microscope. For a full description of the methodology see Baillie (1982). Also see Stokes and Smiley (1968).

Dr Baillie has very kindly supplied me with his original data from which 50 graphs of ringwidth against time have been produced. In total there is data for 37 trees and the graphs were drawn to show the change in ringwidth over time. In some cases two graphs were plotted for one tree in order to provide adequate resolution of the points; some of the graphs have ringwidth plotted on a logarithmic scale to highlight small changes.

Graphs for 4 of the trees are shown over - q2818 (2 graphs), q2824 (2 graphs), q5344, q5261A and q2651. The other graphs were all plotted in this fashion; it was felt unnecessary to include them in this thesis, there being a large amount of repetition, but they can be readily examined.

The labelling of the trees is the same as that used by Dr Baillie. Unfortunately the data can only be matched up with a very small number of actual standing specimens.

SUMMARY OF RESULTS

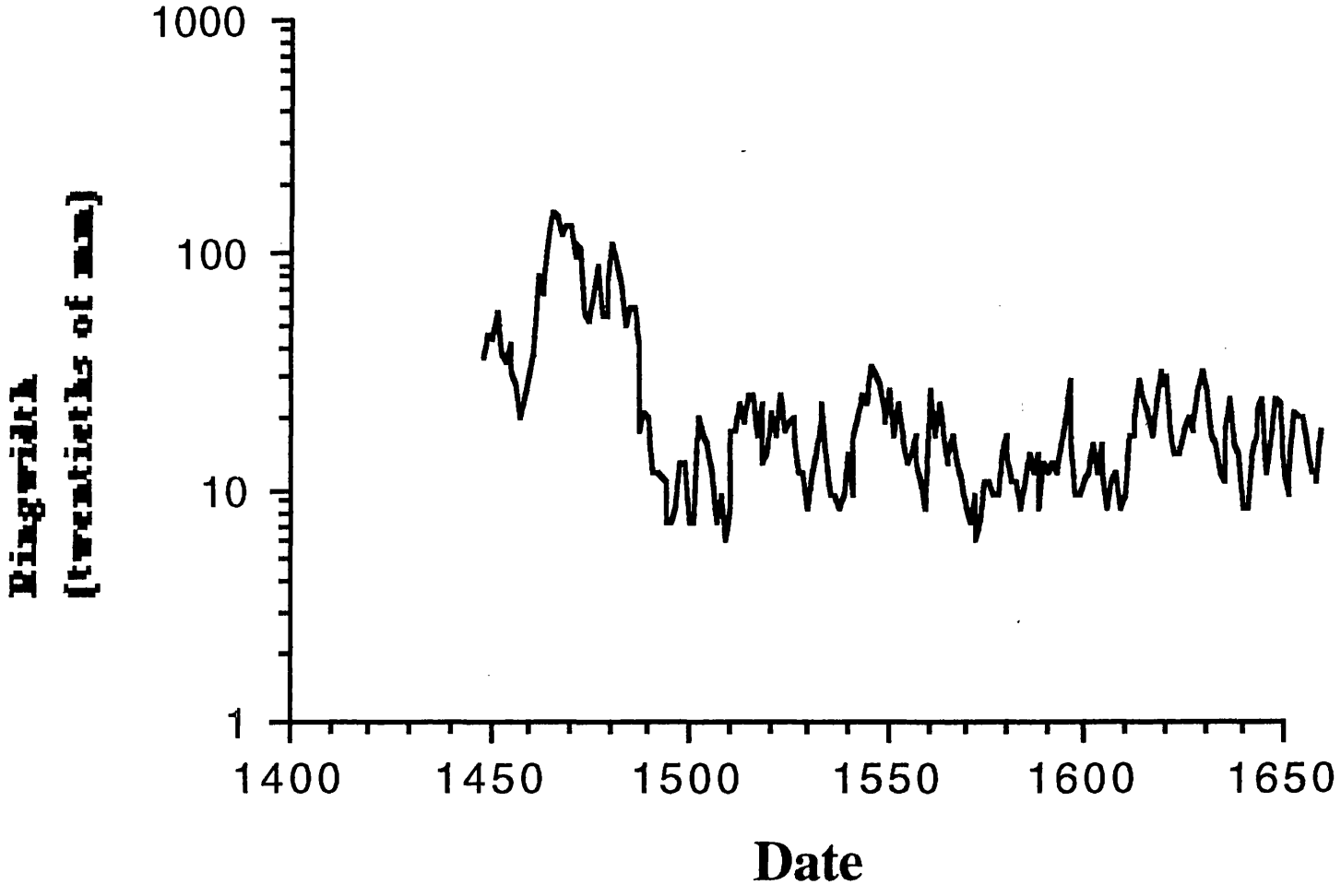
Each individual graph has been analysed to see whether there is any evidence of pollarding:

TREE	DATE OF SAMPLE	OBSERVATIONS
q2818	1444 - 1855	After good growth in early years (10-40) it becomes much reduced and irregular. No evidence of pollarding. (The oldest sample. Stump still visible. Diameter of trunk at 20cm above ground = 60cm. Girth at 20cm above ground = 400cm.)
q2824	1496 - 1920	Considerable fluctuation especially during early years. Quite a large drop after 170 years (ie.in 1667) followed by several poorer years - would be consistent with crown reduction (as from **pollarding**) but otherwise no evidence of pollarding.
q2821	1504 - 1903	Some very large drops in ringwidth eg. after 14 years but recovery immediate. Ringwidths fluctuating greatly. No evidence of pollarding.
q2822	1507 - 1906	Considerable fluctuation. No evidence of pollarding.
q2823	1507 - 1906	Considerable fluctuation. No evidence of pollarding.
q2819	1529 - 1831	Considerable fluctuation. No evidence of pollarding.
q2825	1534 - 1959	Considerable fluctuation. No evidence of pollarding.
q5094	1587 - 1981	Considerable fluctuation. No evidence of pollarding.
q2652	1597 - 1921	Considerable fluctuation. No evidence of pollarding.
q5092	1636 - 1925	Significant drop in ringwidth after 6 years (ie. in 1642) from 122 to 76 twentieths of a millimetre with recovery to former levels not occurring until year 20. This would be consistent with **pollarding.** Otherwise ringwidths fluctuate irregularly.

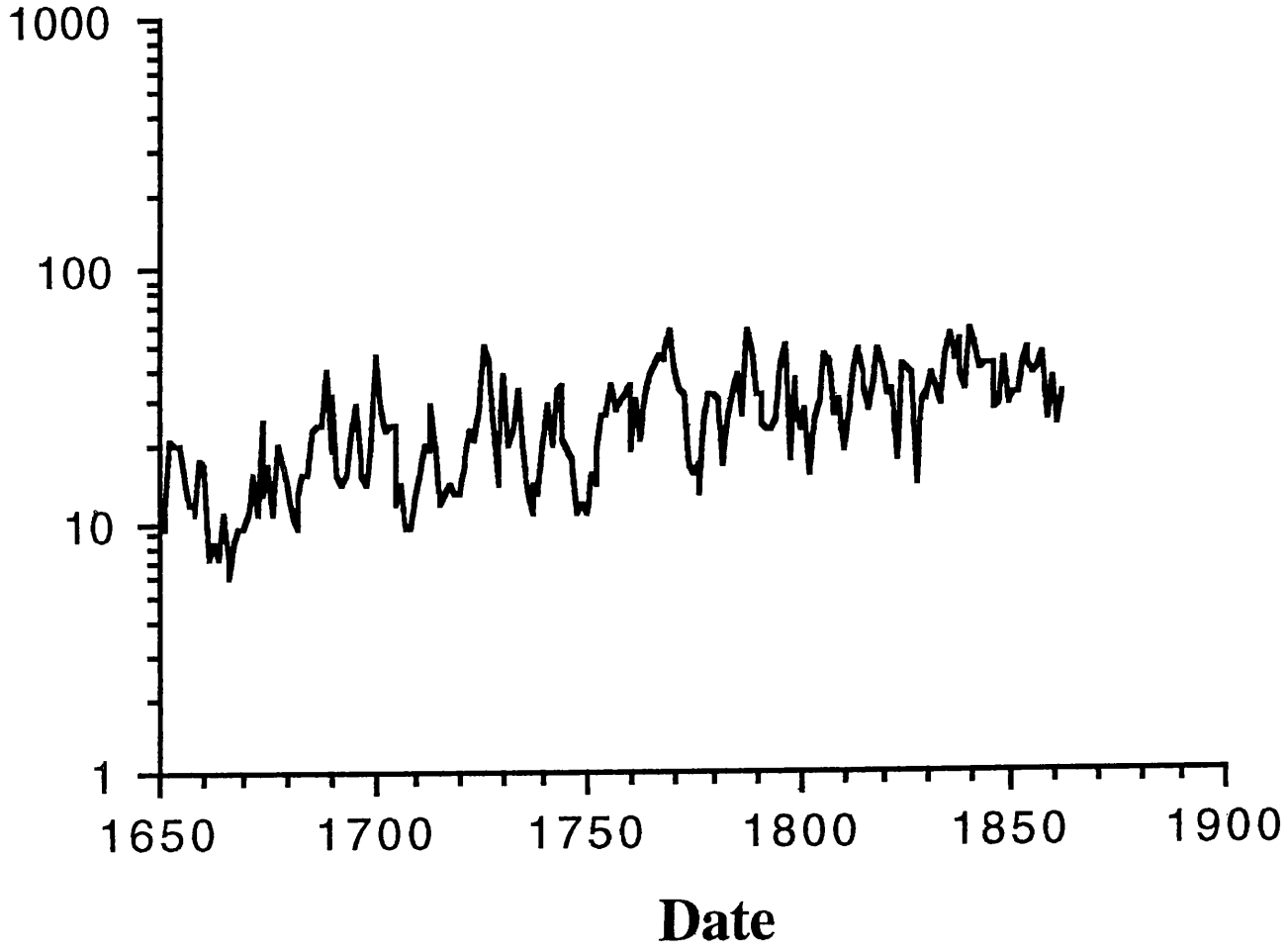
q5101	1636 - 1925	Considerable fluctuation. No evidence of pollarding.
q2820	1691 - 1960	Possibly **pollarded** after 51 years (ie. in 1733).
q5091	1699 - 1968	A fast growing tree - some annual rings > 10mm. Large drop in ringwidth after 234 years - possibly through **pollarding.**
q5261A	1704 - 1873	Considerable fluctuation. No evidence of pollarding.
q5095	1705 - 1923	Many large fluctuations but possible **pollarding** after 104 years (ie. in 1809) - large decrease in ringwidth followed by slow recovery.
q5097	1716 - 1944	Considerable fluctuation. No evidence of pollarding.
q2651	1733 - 1906	Considerable fluctuation. No evidence of pollarding.
q5364	1742 - 1984	Considerable fluctuation. No evidence of pollarding.
q5104	1745 - 1979	Considerable fluctuation. No evidence of pollarding.
q5349	1755 - 1984	Considerable fluctuation. No evidence of pollarding.
q5098	1757 - 1959	Considerable fluctuation. No evidence of pollarding.
q5335	1764 - 1984	A rapidly growing tree. Considerable fluctuation. No evidence of pollarding.
q5102	1777 - 1979	Considerable fluctuation. No evidence of pollarding.
q5344	1783 - 1984	Possible **pollarding** after 65 & 140 years (ie. in 1848 & 1923) although decreases in ringwidth relatively small (approx ½ previous widths) and recovery within 8 years.
q5267	1784 - 1983	Possible **pollarding** after 154 years (ie. in 1938), otherwise considerable fluctuation, no evidence of pollarding.
q5266	1785 - 1983	Considerable fluctuation. No evidence of pollarding.
q5269	1787 - 1983	Considerable fluctuation. No evidence of pollarding.
q5343	1796 - 1984	Considerable fluctuation. No evidence of pollarding.

q5253	1808 - 1983	Considerable fluctuation.	No evidence of pollarding.
q5262	1827 - 1983	Considerable fluctuation.	No evidence of pollarding.
q5099	1832 - 1971	Considerable fluctuation.	No evidence of pollarding.
q5100	1882 - 1981	Considerable fluctuation.	No evidence of pollarding.
q5259	1888 - 1983	Considerable fluctuation.	No evidence of pollarding.
q5265	1898 - 1983	Considerable fluctuation.	No evidence of pollarding.
q5260	1900 - 1983	Considerable fluctuation.	No evidence of pollarding.
q5103	1900 - 1979	Considerable fluctuation.	No evidence of pollarding.
q5255b	1919 - 1983	Considerable fluctuation.	No evidence of pollarding.

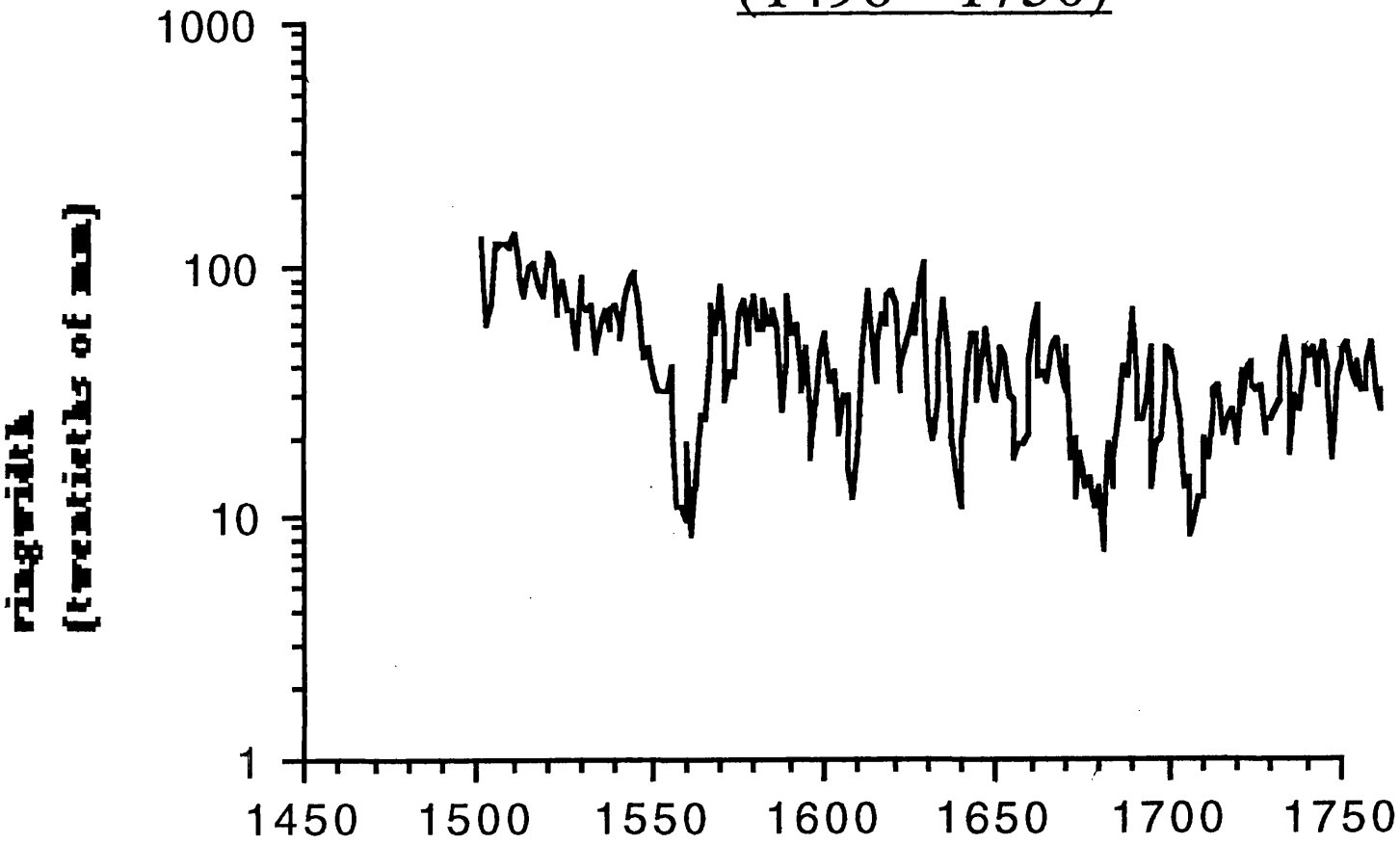
q2818 (1444 - 1650)



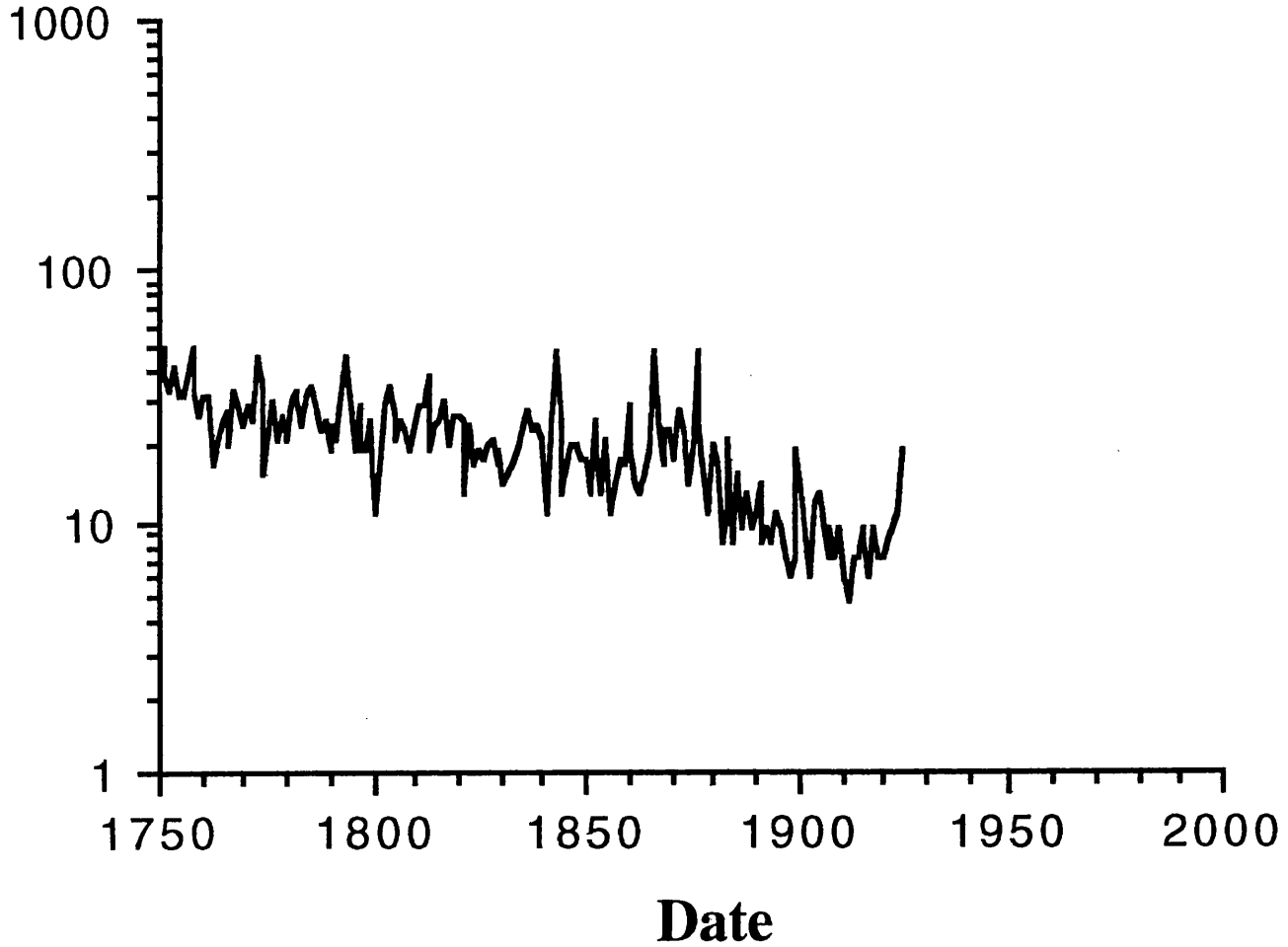
q2818 (continued)



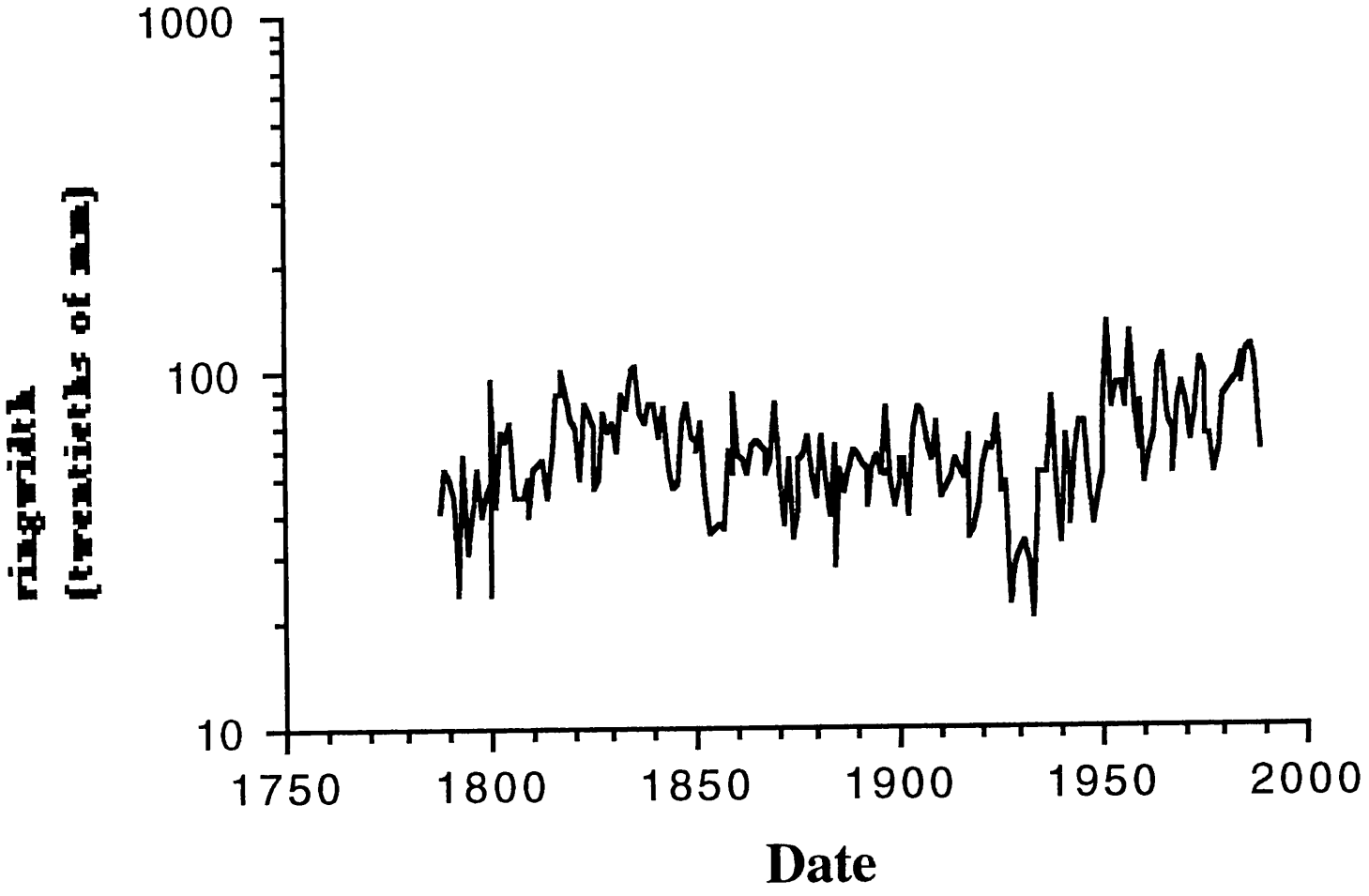
q2824
(1496 - 1750)

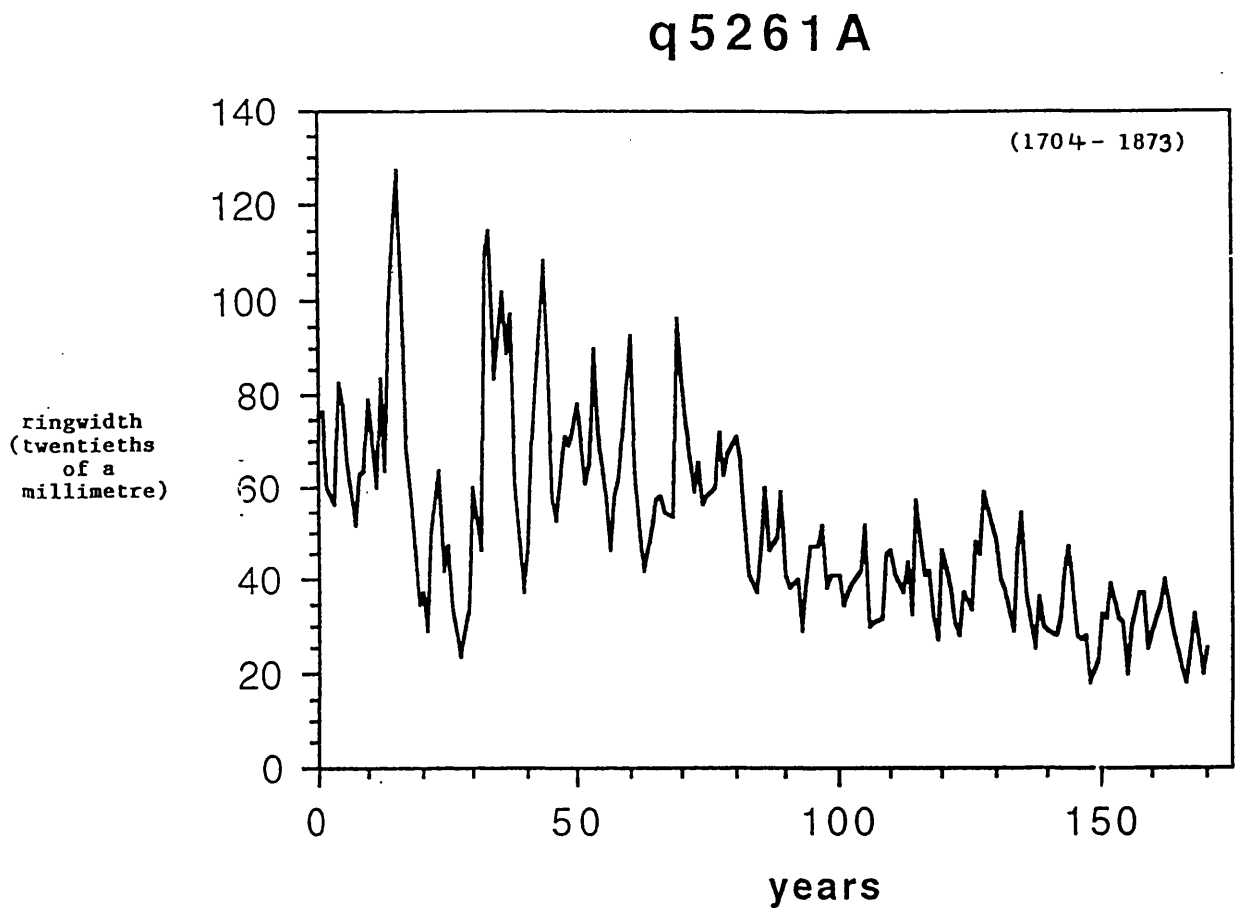


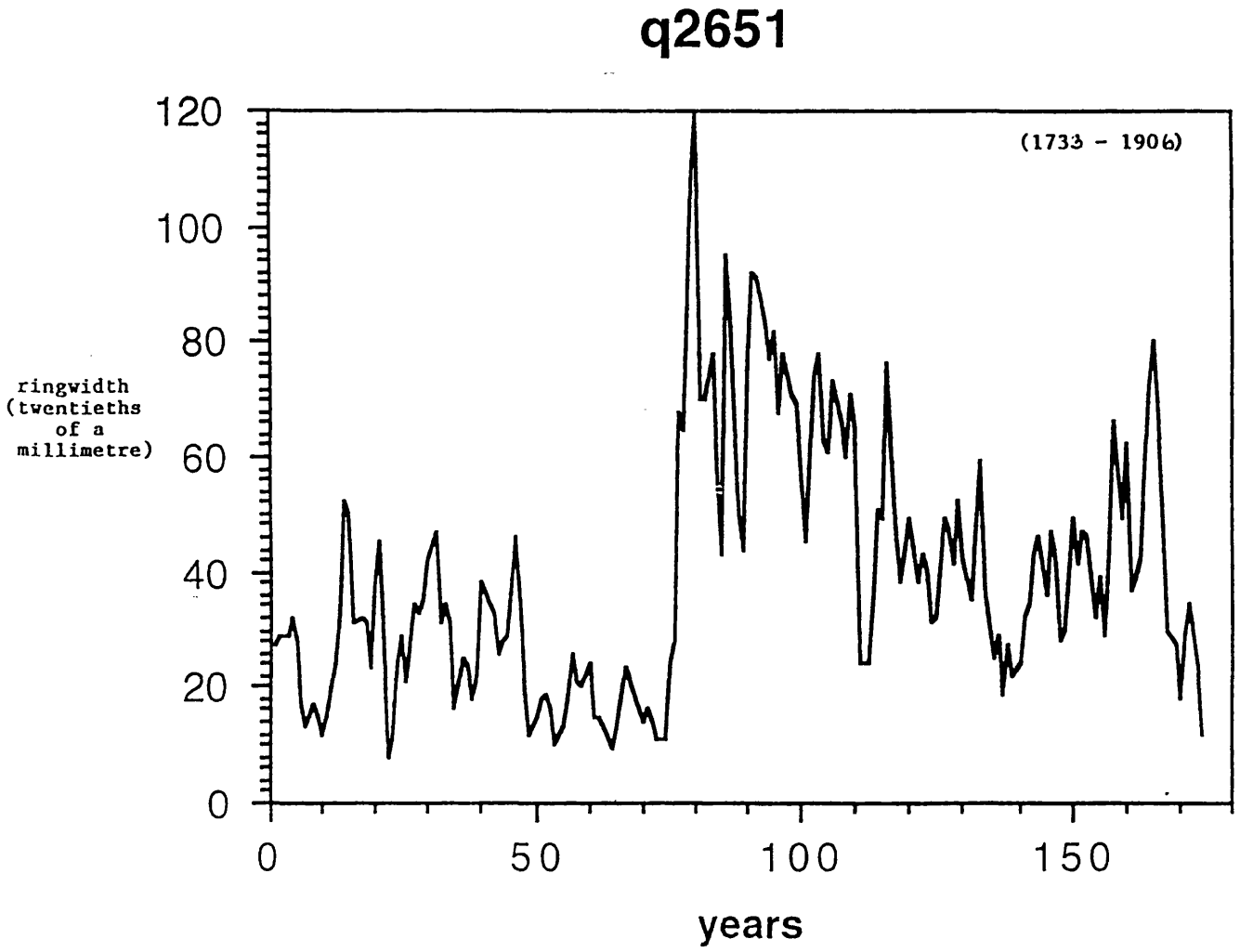
q2824 (continued)



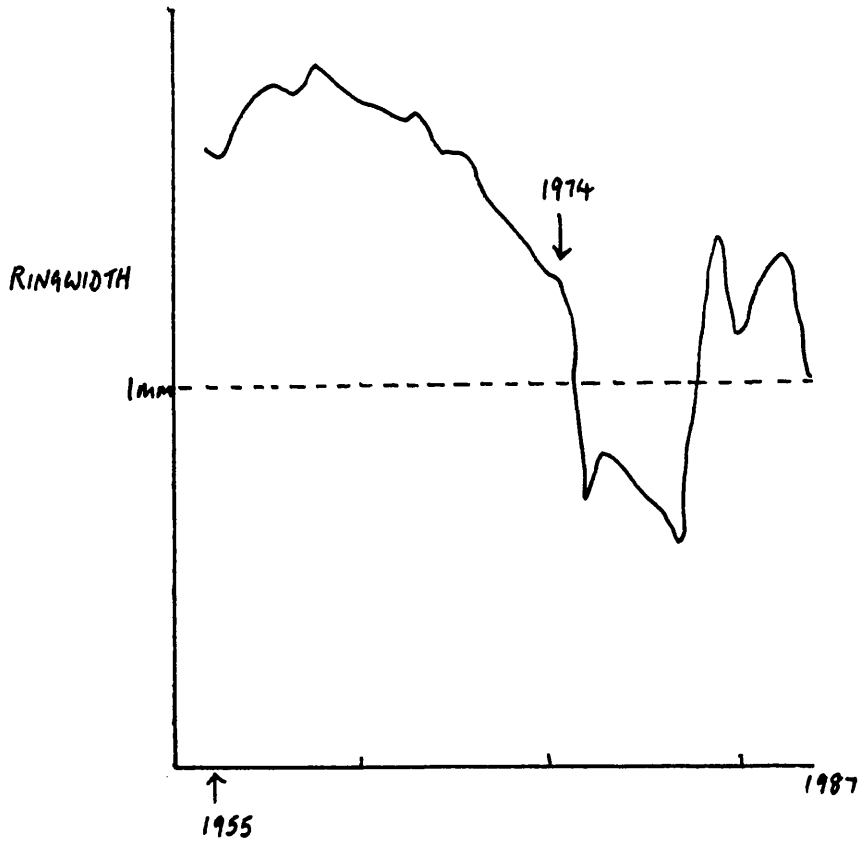
q5344


1000
100
10
ringwidth
[twentieths of mm]
1750
1800
1850
1900
1950
2000
Date


q5261A
(1704 - 1873)
ringwidth (twentieths of a millimetre)
140
120
100
80
60
40
20
0
0
50
100
150
years


q2651
(1733 - 1906)
ringwidth (twentieths of a millimetre)
120
100
80
60
40
20
0
0
50
100
150
years

Copy of graph from Rasmussen (1990) showing the effect of experimental pollarding on an ash tree. The tree was pollarded for the first time in 1974 and the decrease in ringwidth is considerable.



DISCUSSION

Ringwidth fluctuates considerably in these trees. This is to be expected since environmental factors also fluctuate so much. However very little pattern is observable amongst the trees even when the growth of different trees at a particular time is compared. For example as described for Hayley Wood, Cambs. (see page 66) caterpillar defoliation during the early decades of this century resulted in considerable growth retardation throughout the oak population. Examination of the data for Cadzow reveals that this may have been occurring in some of the oaks which have been analysed but it was obviously not a predominant growth factor. Six of the trees (q5260, q5265, q5099, q5253, q5266,and q5102) possess significantly narrower ringwidths during this period but most do not.

What is clear is that in the graphs for these 37 trees there are only eight instances of a significant drop in ringwidth followed by a gradual recovery, as one would expect to find following pollarding of a tree. These instances are summarised below:

TREE	POSSIBLE DATE OF POLLARDING
q2824	1667
q5092	1642
q2820	1742
q5091	1733
q5095	1809
q5344	1848
	1923
q5267	1938

The lack of more examples like this provides strong evidence of a general absence of pollarding. Moreover in each of the cases cited above there are numerous other possible explanations for the drop in ringwidth eg. defoliation by caterpillars, fungal attack etc. Even if all these trees were pollarded at the date shown above this would still be an entirely different situation from that implied by Kirby for Cadzow (see page 11) and as practised in many other wood pasture systems eg. Epping Forest (Rackham 1980). In such cases there was a sustained and systematic programme of pollarding of the trees. Analysis of the annual rings produced over the last 548 years by these 37 trees shows that this simply was not the management practice at Cadzow in the period since 1444.

-6-

HOW OLD IS CADZOW?

Introduction

Local folklore states that the Cadzow Oaks date from the 12th Century. For example the author of the New Statistical Account of Scotland (1845) states that they were planted about 1140 by David I (see page 38). As has been shown (see page 10) the trees are undoubtedly of considerable age. However, this description raises two intriguing and interconnected questions:

a) Were the trees indeed planted or are they growing there naturally?

b) Is this an example of **ancient** woodland?

If the trees were planted (even in the 12th Century by David I) does this imply that the area of woodland is not "ancient" in the commonly used sense? Perhaps surprisingly it would be quite possible for it to be ancient and still to be planted, according to some authorities. Rackham (1980) defines an ancient wood as one which has been present since A.D. 1700 or earlier, while Peterken (1981) is in broad agreement with this although he considers pre-1600 woodland as ancient. This does not preclude the possibility of the trees being planted

but nonetheless the vast majority of woods which have been in existence since 1600/1700 will indeed be natural rather than planted (Rackham 1980). Such a claim is substantiated by considering the history of British woods - the destruction of woods has far outweighed their creation and old secondary woods of known age are very rarely more than 300 years old. Steven and Carlisle (1959) define native woodland (which is slightly different) as woodland which became established in Scotland during post-glacial times without human influence and which has since descended from one generation to the next by natural means.

By some definitions then Cadzow is an area of ancient "woodland" (or, more correctly, ancient wood-pasture), whether planted or not. However more significant is its actual origin. Three main possibilities for this exist:

a) The trees were planted (by David I or some other).

b) The trees are present as a result of natural regeneration but the wood is still secondary. This would mean that there has not been continuous woodland cover on the site. Instead some factor, anthropogenic or natural eg. a humanly started or natural fire, had removed the trees and that the area has since been naturally recolonised.

c) It is an area of primary woodland. There would thus have been uninterupted cover of trees since the last Ice Age retreated and colonisation of the exposed land took place. Pollen analysis of sites throughout this area of Scotland have

shown that by 8000 BP oak colonisation had occurred from the south, such that by then it was a major forest component (Birks 1989).

Both Rackham (1980) and Peterken (1981) state that it is almost impossible to assess whether or not an ancient wood is primary. However in nearly every case it will be on a primary woodland site. This is surely the case for the Cadzow oaks - it is not conceivable that an area of gently sloping land at altitude of 100m in this part of Scotland would not originally have been wooded.

Is it then primary or secondary in nature? The interference by man over the centuries has been such that little information can be obtained about the origin of the trees by looking at their present nature and composition. Although standard ecological observations can be made their interpretation is problematic. For example if the trees had the appearance of an even-aged stand this would not necessarily imply that the area was secondary (planted or otherwise) as might have been the case with a young stand of trees. At Cadzow such a pattern, if present, might simply result from all the oldest trees having died, leaving only the youngest. And if it were found that the trees showed a greater uniformity in growth habit, fruiting characteristics etc. than one might expect in a natural population this would not necessarily have resulted from the planting of a crop of acorns of related or

similar parentage. It is equally possible that the management of wildly growing trees over the centuries has selected those trees that exhibited particular desirable characteristics. A relatively homogeneous stand could thus have been nurtured from a disparate, naturally occurring mixture of individuals by selective culling of undesirables.

The most significant feature of these trees is their age - the greater their age the smaller the likelihood of them having been planted. The oldest dated stump on the site is from 1444 although it is possible that some of the presently standing trees may be even older. This stump is described on page 10 (and has possibly been identified as Dr Baillie's sample q2818 - page 69). The remarkable feature of this stump is that despite 440 years or more of growth it is quite small. The girth of the trunk is only c.12' (400cm) and its radius is only 30cm. Many of the trees still standing are considerably larger than this eg. with girths of more than double this and so one might deduce that they are even older.

"Coring" the trees would theoretically provide an accurate assessment of their age. This technique involves the use of a Swedish increment corer which is bored into the centre of the trunk. When unscrewed a thin core is removed from the tree and this will contain a record of the annual rings in the xylem. The amount of tissue removed is minimal and the hole in the bark is then plugged with a wooden dowel, thereby reducing the

danger of infection. The age of a living tree can then be counted. Permission was received from the landowner, Mr Robert Wiseman, and from the Nature Conservancy Council for Scotland (now Scottish Natural Heritage) to core some of the trees in order to establish their age, however all attempts proved unsuccessful.

It was always realised that the hollow centre to the trunks would mean that the core was incomplete, however it was hoped to obtain some measure of the rate of growth. This would be achieved by measuring how many years were required to effect a given increase in girth and then to extrapolate from this to provide an estimate of the overall age of the tree. Potential sources of inaccuracy, such as the normally faster growth rate in the early years of a tree's life would have to be accounted for, but it was still hoped to obtain some estimate of the rate of growth.

Attempts at coring had little success. The main problem was that the decay in these trunks was such that only very small portions of the trunk were intact and useable. This meant that no useful cores were obtained.

Nonetheless it is still possible to speculate on the age of some of these trees. As stated the girths of some of these trees are considerably larger than the average for oak trees and indeed this is one of the unique aspects of the Cadzow

oaks. However this large girth is often allied to a small crown and this combination is highly significant. If a tree can produce a large full crown then naturally it will grow rapidly in all respects and a large girth will be produced in a short space of time. However if, through environmental or genetic causes, the size of the crown is restricted then a large girth can only have been produced over a considerable number of years. The peculiar combination of a large girth and a relatively small crown is exemplified by one of the Cadzow oaks in particular (plate 2b). Outwardly this appears to be the oldest of the oaks and some estimate of its age has been attempted:

- the relationship between diameter and age described for the stump above ie. 440 years growth in a radius of 30cm, is taken as being indicative of a very slow growing tree such as this one must be

- the girth (circumference) of this tree is 760cm (25') therefore the radius will be 120cm.

- the trunk is thus FOUR TIMES the size of the slow growing stump and it is thus not unreasonable to speculate that even if it had grown more quickly than this tree it could still be at least twice the age of it. This would imply that the tree was at least 800 or 900 years old and thus began life sometime around A.D.1100.

Such extrapolation of data from one tree to another is of course fraught with hazards and this estimate of the tree's age

must be treated with caution. Nonetheless such trees are not unknown. Schadelin (1905) describes a Q.robur "torso" 16m tall and of 759cm girth on St.Peter's Island, on the Lake of Bienne, Switzerland, which was at least 930 years old (on the basis of ring counts). This would be considerably older than most trees but not unique. Dickson (1993) discusses the age of yew trees in Scotland, the celebrated tree at Fortingall in Perthshire perhaps being well in excess of 1500 years old.

Jones (1959, page 192) states "Undoubtedly declining oaks may remain alive for a very long time, so that it is not improbable some of our bigger decrepit trees are of a comparable age to the above two trees." (He is referring to this oak from Switzerland and another slightly younger tree.) Mitchell (1974) uses the growth rates of oaks of known age to calculate typical growth rates and these are typically more rapid than that measured at Cadzow. If this ancient individual at Cadzow has grown as indicated by him then its age would be considerably less than predicted above. Accurate estimates are impossible and it may be that the age is no greater than 400 years. Nonetheless, spectacularly slow growh has definitely occurred in some of the Cadzow oaks. Suggesting that this tree is 800 - 900 years old is not unrealistic.

Whatever the exact age of this tree it is apparent that many of the Cadzow oaks date from the 15th and 16th Centuries. Although planting of trees is not known to have been

commonplace at this time it cannot be ruled out. If the trees are older than this then the likelihood of them being of natural origin as opposed to being planted increases significantly. Ultimately no firm conclusions can be drawn about events which occurred centuries ago.

As stated the author of the NSAS was of the opinion that these trees dated from the time of David I and yet the author of the OSAS says that they are "the last remains of the antient forests, which, in former times overspread the country." The implication is that he thought that these forests pre-dated man's interference and hence were primary forest. Anderson (1967) was also of this opinion. He states that the creation of parks "gave protection to fragments of the former natural forest, as at Dalkeith and Cadzow." However no evidence is cited to justify this assertion and he does state that there may be some truth in the alternative theory (that they were planted) "for the old oaks of Cadzow are of a very unusual variety" (page 147).

Some of the wood is undoubtedly secondary in nature since some of the trees are clearly growing on old earthworks (Plate 3b) which look like the remnants of ridge-and-furrow cultivation. The furrows are quite widely spaced (about 6m) and the lines of the furrows do not run straight. This is characteristic of medieval or older ridge-and-furrow, more recent cultivation being straighter and narrower. The furrows

at Cadzow have a slight curve. The trees which are in this area stand proud on top of the ridges and the furrows indicating that they are chronologically later than them. This would not be so likely if the furrows skirted individual trees.

Ploughing in the area of the old oaks is mentioned in the estate accounts of 1797 (see page 45). However this date does not necessarily refer to this particular area. This runrig could be much older. More significantly such signs of cultivation are only in a small part of the total area and the other trees may be of much older origin. There is no major difference between the appearance of these trees, which must be of secondary origin, and those from elsewhere although none of the largest trees are found on these earthworks.

What then of the legend concerning David I? It has been shown that the present trees are possibly old enough to have been planted in the 12th century or indeed they could be the natural successors of trees which were. Neither of the two Statistical Accounts provides any support for their claims and the position is well summed up by Boyd Watt (1910) (page 14):

> "Traditions such as these which assert that the old Oaks of Cadzow forest were planted by David, Earl of Huntingdon, afterwards David I (1124 - 1153), ... seem to be supported only by constant repetition, not by any proof or authority"

A summary of the history of the trees is given in the following table.

HISTORY OF CADZOW AND ITS OAKS

pre 1100	area part of Scotland's natural woodland(?).
1100 -1200	possible start of life of one of the existing trees.
	legendary time of planting by David I (1124 - 1153).
1444	oldest dated oak began life (died in 1855 but stump remains).
1596	large area of trees clearly marked on Blaeu's atlas (1658), surveying carried out by Timothy Pont in late 16th Century.
1667	first clear written record of the trees: "then went to the wood, which is of a vast bounds, there being great oakes in it yet; rode through the lenth of it, it is thought to be 5 miles about".
1695	reference to "tall oaks" here.
1700 - 1800	Hamilton Estate records show that the oaks were protected in an enclosure, some wood from the damaged trees was used for fencing, for charcoal and for tanbark, but the area was primarily maintained as a chase.
1732-44	Chatelherault built as a hunting lodge for James, 5th Duke of Hamilton.
1791	description in Old Statistical Accounts of Scotland, the trees being noted as being old, very large and already something of a curiosity: one tree said to be 27ft in girth.
1845	description in New Statistical Accounts of Scotland, one tree said to be 36ft in girth.
1858	area of park c. 760 acres, the actual spread of the trees being similar to that in 1946 (when aerial photographs become available) although the most outlying trees had been removed by 1946.
1946-65	steady removal of trees from parts of the estate.
1978	Chatelherault Country Park created from part of the estate together with a section of the Avon gorge: a small number of the ancient oaks within the boundary of the Country Park, most in Hamilton High Parks, sold to Mr Robert Wiseman.
1952, 1971, 1984	gorge and most of old oaks in areas notified as Sites of Special Scientific Interest.
1979	11 old oaks known to have been cut by Mr Wiseman, Tree Preservation Order then imposed.
1981	Voluntary Agreement protecting the oaks signed between Mr Wiseman and NCC.
1981 - 93	no significant change in the state or number of old oaks although one or two have been severely damaged or have died as a result of vandalism.

-7-

CONSERVATION AND FUTURE MANAGEMENT

The oaks of Cadzow may have lasted for many centuries but not unscathed. The cut stumps in the fields and the historical references to a much more extensive forest testify to a serious reduction in their numbers. The existence of aerial photographs makes it is possible to be precise about the changes that have occurred over the last half century. The earliest is from 1946 (over) and it is clear that many of the trees have disappeared since then. Indeed the area of oaks which has disappeared exceeds that which remains, although it must be said that the trees in the cleared areas were often widely spaced. The areas which are now totally cleared have been marked on the photograph, but even in the other areas there has been a decrease in the density of the trees.

For many people the loss of so many of the trees can only be viewed with regret and they would now strive to prevent any further losses. For them there is a special magic about the weird and twisted shapes; about the great age of these organisms; about the centuries through which they have survived; and about the fact that they could possibly be

= area of ancient oaks present today
= area of ancient oaks no longer present

Aerial photograph of Cadzow Oaks

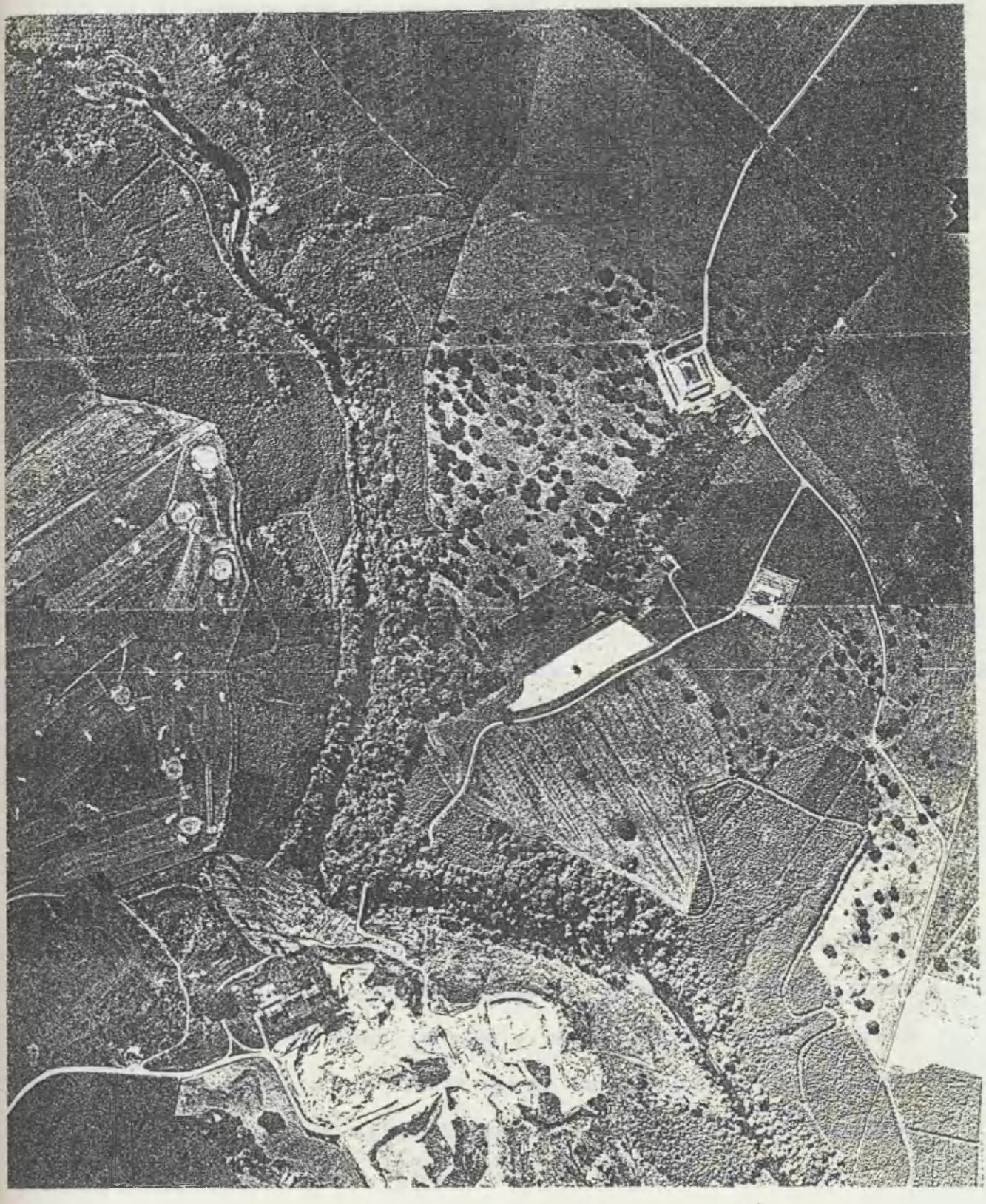
Date: 1946

Scale: 1:10 000

Aerial photograph of Cadzow Oaks

Date: 1946

Scale: 1:10 000



Aerial photograph of Cadzow Oaks

Date : 17/7/65

Scale: 1:10 000

ancient remnants of the original "wildwood". Whatever the precise reason, the trees do arouse strong feelings and local people are fiercely proud of their ancient oaks.

Yet if time and money are to be spent conserving this landscape and protecting it from further damage more concrete and less subjective arguments must be proposed. In his Nature Conservation Review Ratcliffe (1977) lists several key features which are of particular importance when assessing the value of a site for nature conservation. Of particular relevance to the oaks at Cadzow are the following:

A. Uniqueness (together with Peterken's associated concept of non-recreatability (Peterken 1981)).

The age of these trees makes them almost unique in Scotland. Some large and ancient trees are to be found in the grounds of Dalkeith Palace although this is a coppice wood which has not been cut for centuries (Fairbairn 1972, Rackham 1990, 1994). There are also some large oaks at Lochwood, near Moffat (NY 0897) in what is now a wood pasture but the trees are less remarkable in their size and their apparent age. Apart from these two sites there is nowhere else in Scotland known to me where such trees can be found. Other areas of ancient wood pasture can be found in England eg. Monk's Park, W. Suffolk (Rackham 1980) but nowhere are they common. At any geographical level Cadzow represents a type of vegetation which

was once much more widespread than it is now and in Scotland it is almost unique.

Moreover the Cadzow oaks are surely the epitome of "non-recreatability" - the possibility of recreating another area like this is arguably significantly less than for any other vegetation type in Britain. This is by virtue of the very age of the trees. It is clear that many of them are at least 400 years old and some may be considerably older than this. Existing oak woods may contain 200 - 300 year old trees but centuries would be required before they could conceivably come to resemble those at Cadzow. Man can artificially speed up many processes but it is only the passage of time itself which can produce more trees like the Cadzow oaks.

B. If rare species are present in an area then this makes it of greater importance. As shown (see page 15) the trees themselves are not of an unusual nature and the ground flora of such wood pasture is unremarkable. Only those species which are unpalatable or are capable of withstanding constant defoliation will survive. This is certainly the case at Cadzow with a floristically poor sward of "improved" grass growing beneath the trees.

Nonetheless this wood pasture is in fact an exceptionally important habitat for several rare species of organism. Rackham (1980) describes how the old dry bark and the red-

rotted cavities of ancient trees are an essential environment for several species of invertebrate and lichen. Crowson (1961) and Crowson (1964) have shown that there are several interesting species of beetle and spider found on these trees. Rose (1974) states that the peculiar requirements of many species of lichen include old acidic bark, high humidity, freedom from pollution, and freedom from contamination from fertilizers and animal excreta. The correlation between particular lichens and old trees is such that they can be used as indicator species for ancient woodlands (Rose and Wolseley 1984). These requirements are often met in an ancient wood pasture system, such as Cadzow. I know of no specific study of the lichens of the Cadzow oaks and it is outwith the scope of this research to carry out such a study. It does seem likely that they would be found to be richly colonised by epiphytes.

C. A site which is <u>natural</u> is often considered to be of more value than one which is not. Cadzow is patently not a natural type of vegetation even although it is ancient vegetation and it could possibly be primary in nature. Peterken (1981) states that truly virgin forests survive only in remote parts of Central and Eastern Europe and Rackham (1980) specifies that such can be found in Bialowieza, Poland. The British Isles contain no really natural woodland, scrubby fragments on cliffs and in gorges being the closest approximation found here. All others have been altered in structure, if not in composition, by centuries of woodland management (Kirby 1986).

Yet in some cases, such as Cadzow, some of the interest and value stems from the very fact that the vegetation is not natural. Instead it is an example of a type of vegetation which has been deliberately managed in a particular way. As has already been argued the management of the Cadzow oaks may have been no more active than the initial spacing of the trees and their subsequent preservation as an integral part of the "chase" (as oppossed to pollarding or shredding) but the overall effect is that a unique community of plants and animals has resulted. Such communities are not found in wild unmanaged woods. They typically arise when trees are managed in this fashion and it is surely very important to preserve the living results of past methods of management. They constitute a living museum, providing a wealth of information about the past.

The value of Cadzow is thus not in question. Is its future? A few of the trees (less than ten) are in the grounds of Chatelherault Country Park and one of its management aims is to enhance its wildlife potential. The Park Ranger Service are well aware of the value of the resource which these trees represent and they actively protect the trees and use them to educate the public. Unfortunately the vast majority of the trees are in the grounds of Hamilton High Parks Farm, the land mostly being used for pasture.

Some of the trees are in an area which has been underplanted with conifers and these are now threatening to overtop and choke the oaks. An immediate approach to the owner, Mr Robert Wiseman, regarding these trees is essential if they are to be saved. The majority of the trees are in an area of pastureland and commercial interests could conflict, as they have in the past, with the preservation of the ancient oaks. The majority of the trees on the High Parks farm are within a designated S.S.S.I. Despite this in 1979 it was drawn to the attention of the Nature Conservancy Council that eleven of the trees had been felled without prior notice or permission. Consequently a Tree Preservation Order was imposed on the area. In 1981 this was replaced by a Voluntary Agreement. This forbids the cutting down, topping, lopping, uprooting or otherwise damaging of the trees without prior permission. There is no evidence to suggest that this agreement has been breached since. Further the Agreement stated that the two parties were to enter into discussion regarding the regeneration of the oaks although no action has been agreed upon.

In 1989 Keith Kirby visited the site for the Nature Conservancy Council. Following this visit it was proposed to Mr Wiseman that planting or regeneration should be encouraged in certain areas to provide for continuity in the future. This suggestion was rejected and there have been no further approaches to Mr Wiseman on this matter. It should however be

noted that he is sympathetic to this present research and wishes to be informed of all findings.

Is it really necessary to embark upon a programme designed to ensure the trees' regeneration? Can the area not simply be preserved as it is using the voluntary agreement which has apparently been successful until now? Certainly there will be a slow and gradual reduction in the numbers of the trees as they succumb to the weather and to occasional vandalism but this decline will surely be extremely slow, perhaps taking centuries. In the short term would the present strategy not be adequate?

This may be so but it can be argued that there could still be value in encouraging regeneration of the trees in some areas. Such an argument can only be justified if certain motives are behind the the conservation of the oaks. If the trees are to be valued simply because they represent an ancient form of tree management then to begin managing new areas in this way seems somewhat contrived. However if the trees are being preserved because of their intrinsic value and appeal then beginning the whole process of creating others like them could be deemed justifiable. This is despite the fact that no results will be forthcoming for hundreds of years. A more compelling reason for creating new areas which in time might come to resemble the present area of oaks would be to provide continuity for the other organisms that rely on these trees.

Any break in the presence of such ancient trees in the locality could conceivably render these organisms extinct.

Such a strategy has recently been employed in the neighbouring Country Park in an area close to the present oaks. Acorns from the ancient oaks have been collected and planted on the edge of the Park near the old oaks. Centuries will of course pass before these trees acquire the characteristics of the ancient oaks and it is unclear how rapidly they are declining - if the decline is more rapid than the ageing of the new trees then it may be impossible to maintain continuity of habitat for these dependent organisms.

The ancient trees are known to have considerable powers of survival as their current shapes, produced by recurrent dieback and regrowth, indicate. However vandalism or an active flouting of the terms of the voluntary Agreement could rapidly transform the situation.

The present management of most of the trees is very similar to that employed in the past since, although the cattle which graze among the trees are not hunted, the area is the modern form of a wood pasture system. The ancient oaks are still "soldiering" on and if Mr Wiseman continues to uphold his commitments then there is little cause for concern. As described above an attempt is being made to foster more ancient

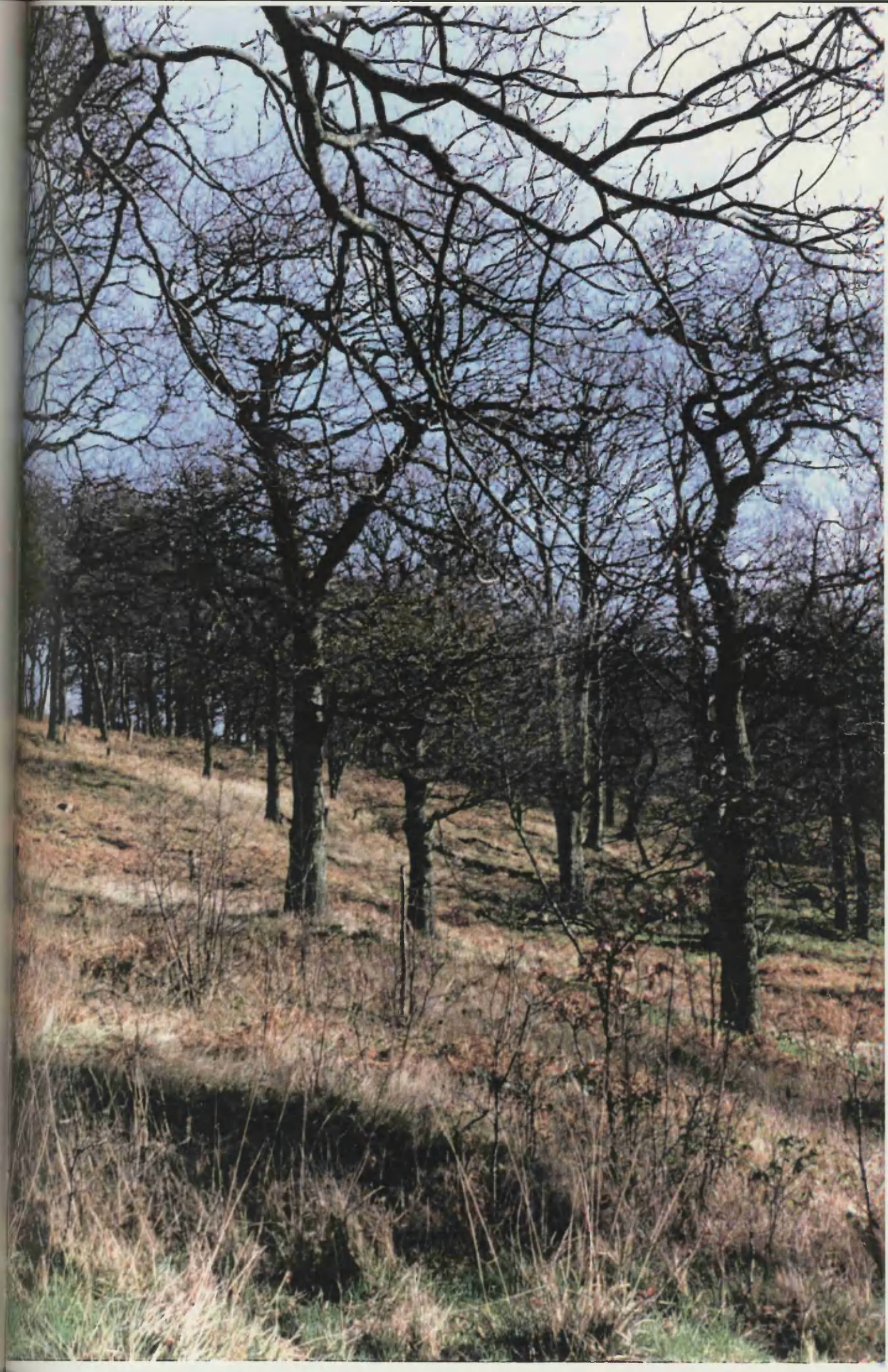
oaks in an abutting area and Chatelherault Country Park should be commended for, and encouraged in, this effort.

These remarkable trees are still vulnerable - it would only take a few hours to end centuries of growth - and their future would only be more certain if the land were owned by a Conservation body and managed specifically for the best interests of the trees. Such an event is obviously unlikely and instead the land will remain as it is. The ancient oaks have now been growing since AD 1500 or possibly even AD 1100. Will they still be alive in AD 2400 or even AD 2900?

PART B

GARSCADDEN WOOD

Plate 4 (over) shows maiden oak trees in the ancient inner core of the wood.



-8-

INTRODUCTION TO GARSCADDEN WOOD

Garscadden Wood (NS 527723) is a place which rewards careful scrutiny. Standing on the north side of a valley, its southern edge now marked by the houses of Drummore Road, Drumchapel, and its northern edge bounded by Bearsden Golf Course, there are few obvious clues about its past. A casual vistor entering only the southern fringes may be very unimpressed - the vegetation is in places more typical of waste ground than woodland and evidence of human interference is abundant.

But venture uphill, away from the houses, and the picture changes. Not only does it become a most attractive wood with an oak canopy and a varied understorey, but in addition it is clearly a wood of considerable antiquity. This has only become apparent after a detailed study as the wood does not have an ancient "feel" or ambience - for example there are no mighty oaks as at Cadzow, nor are there the multitude of large multitrunked oaks which one finds in the Loch Lomond woods (Tittensor 1970) or even in nearby Mugdock Wood (eg see Stevenson 1990).

What then are the indications of antiquity? The first clue came from its inclusion on old maps and within the wood there are some very old, if not very large, trees. Moreover there is an array of earthworks suggesting a number of different land uses in the past.

The wood is approximately tadpole shaped (Dickson 1991, also see maps in Ch 11), the head of the tadpole lying to the northwest. This western end is quite different in nature from the eastern end. Close to the houses the trees are scattered and small but on the northern edge of a track, which cuts right through the wood, the canopy is in most places complete. In this northern area there are two large areas which have been cleared or burnt.

In a large area to the northwest of the wood ie. within the head region of the tadpole shape, there is a large stand of maiden oaks (see map). A row of beech trees marks the northern periphery of the wood. There is also a clear area of Scots Pine at the western end beyond the maiden oaks.

The eastern end, the tail of the "tadpole", appears to be a recent addition to the wood (see Ch 12) and exotics are more common here - sycamore, larch and spruce forming the majority of the canopy. It soon became clear that this area was of recent origin. In addition it is relatively lacking in

botanical interest. It was decided at an early stage to concentrate further studies on the western end of the wood.

It has already been stated that the southern fringes of the wood are less aesthetically pleasing than the upper parts of the wood. Local children are frequently to be seen here and some of their practices are highly destructive. The wood is obviously set on fire frequently and in places the vegetation consists of nothing more than a low scrubby growth and charred tree trunks. Elsewhere there are trees which have survived the fires but they are severely mutilated, having been hacked crudely at various heights. Varying degrees of damage have resulted from this. Litter is not an obvious eyesore although there are several burnt out cars in the lower parts of the wood. Despite this the area is of considerable interest, both the trees and the ground bea ring the hallmarks of ancient woodmanship.

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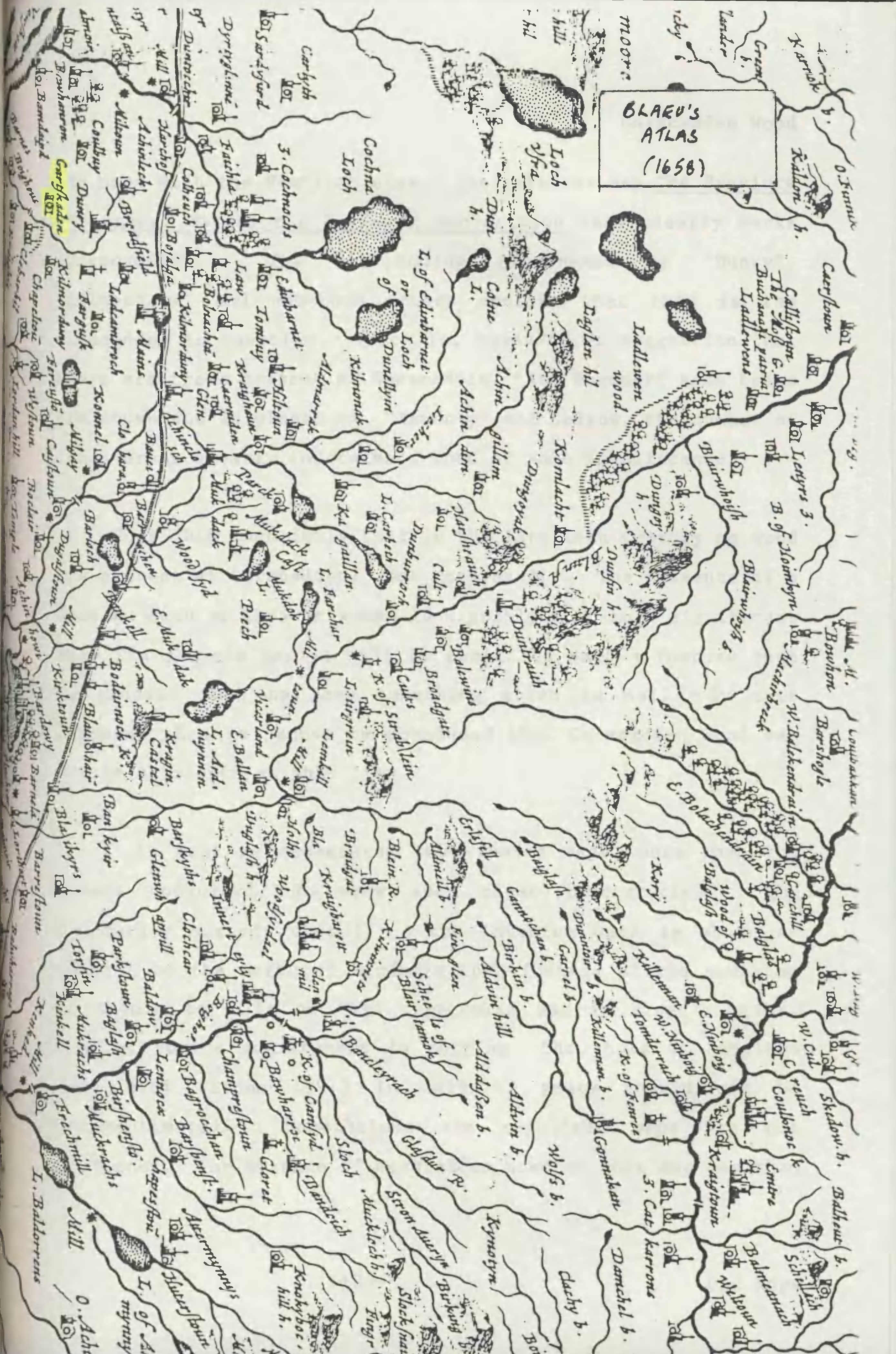
INFORMATION FROM OLD MAPS AND HISTORICAL DOCUMENTS

The value of old maps and the problems faced when using them have already been discussed in Chapter 4. They can be regarded as a useful source of historical information about woods although considerable care has to be exercised in their interpretation, especially if there is no corroboration between different maps.

Since Garscadden Wood is closer to Glasgow than Cadzow it was hoped that there might be more old maps which actually covered this area. Glasgow, being a more heavily populated area than Hamilton, is better documented. Unfortunately the maps of Glasgow which do exist from early times eg. John Watt's A map of the river Clyde from 1734 (Marwick 1909), do not extend sufficiently far to the north west to include Garscadden.

BLAEU'S ATLAS (over)

Timothy Pont's map in Blaeu's Atlas (Blaeu 1654) is the first known map of the Glasgow area (Anon., 1921, p 73), as was


BLAEU'S
ATLAS
(1658)

the case with the Hamilton area. The relevant map The Province of Lennox, called the Shyre of Dun-Britton very clearly marks "Garscaddin". The surrounding placenames eg "Dunry", "Kilmorduny" and numerous others confirm that this is the Garscadden in question. There is, however, no suggestion that there are trees present at Garscaddin. At "Mugdack" some trees are shown and in places eg. "Bardowy" and Cadzow, the number of trees drawn clearly indicates a wood of some significance.

Does this then imply that in the late 16th Century no wood was present at Garscadden? Not necessarily. The presence of a feature such as this on a map is arguably much more significant than its absence ie. it will be easier to omit a feature that is present than to show something which is not. By this argument then it cannot be concluded that Garscadden Wood was not in existence at this time.

It must be remembered that Pont's maps, more than the others consulted, do show some clear inaccuracies. The inaccuracy already quoted - the Antonine Wall is shown as passing to the north of Bardowie Loch instead of the south as it should be - is on this particular map in Blaeu's atlas. Timothy Pont's achievement in mapping the whole of Scotland less c.6% (Stone 1991) in only 13 years should not be underestimated. Nonetheless the resultant maps are not foolproof. The absence of Garscadden Wood on this map may then

be considered of less significance than if this were the case for one of the more modern maps.

THE MILITARY SURVEY OF SCOTLAND (1746 - 1755) (over)

Garscadden Wood is clearly shown. The position of the enclosed wood relative to Garscadden House, Drumry and the Antonine Wall clearly mark this as the wood which is present today. Moreover the shape is not without significance. This, and its orientation (running roughly East-West with a slight leaning to the north), are highly reminiscent of part of the present wood - the western end or "head" of the tadpole shape. This might imply that in the mid 18th Century only part of the present wood did actually exist.

Roy shows on his maps the presence of "runrig" (ridge and furrow cultivation). This particular map shows rigs running away from Garscadden Wood towards the northeast and such a pattern can still be seen today on the ground to the north east of the wood. This is now part of Bearsden Golf Club and the short turf of the fairways reveals unmistakeable ridges and furrows angling away from the wood as marked.


ROY'S MAP
1745-55
Dumky
Chaple Yards
Blair Davidy
Garscubb
Knightswood
Partick
Byres

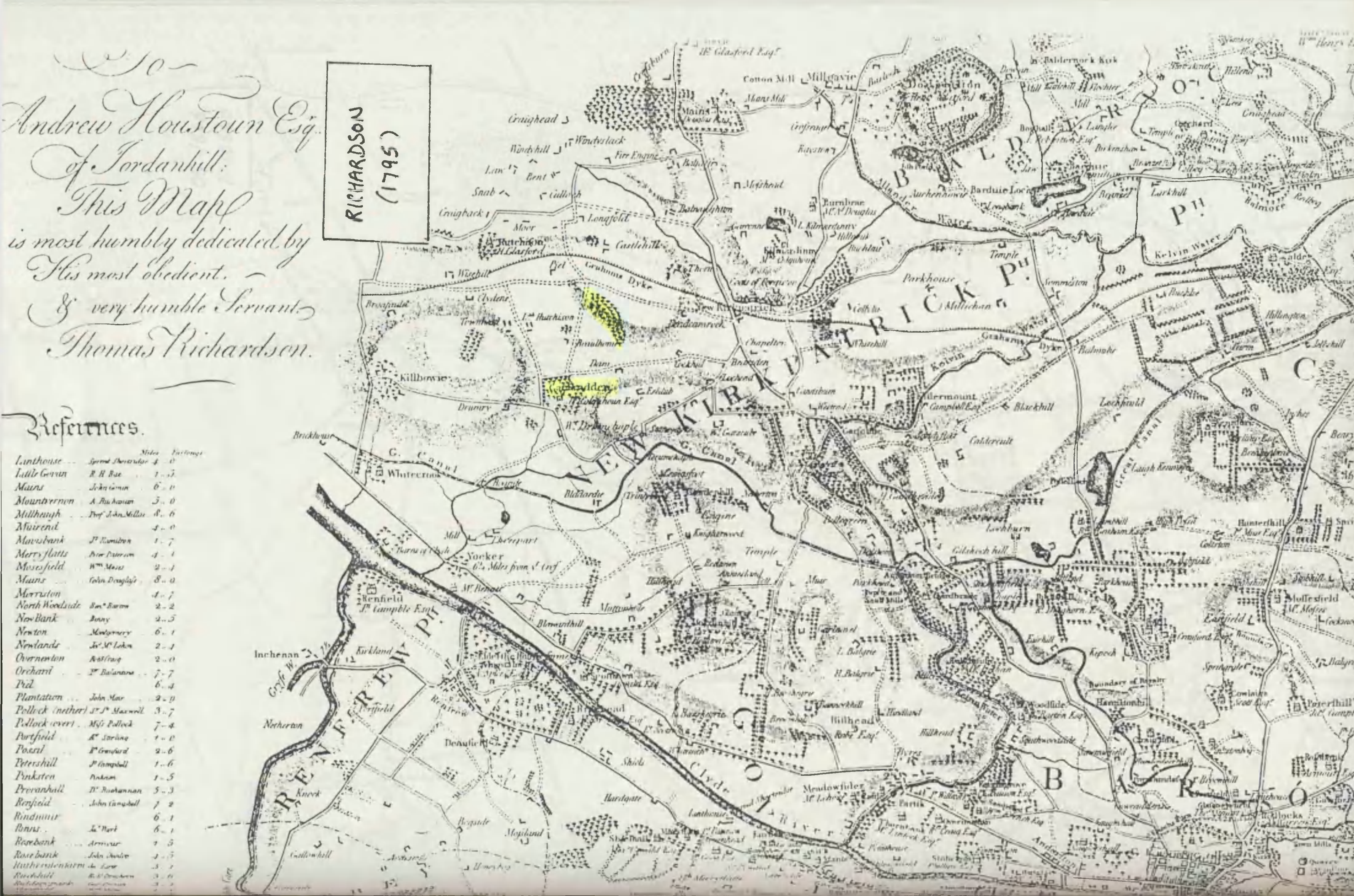
THOMAS RICHARDSON'S MAP (1795) (over)

This map provides confirmation of the existence of Garscadden Wood in the 18th Century and its shape is broadly similar to that shown on Roy's map. It is unclear whether the eastern section (the tail of the "tadpole") has now been added. Certainly there is a suggestion that there is an extra part to the wood at its eastern end although it is pointing more to the south than at present. If this is the present "tail" of the wood then it is either drawn inaccurately or its exact position and boundaries have been changed since then.

ORDNANCE SURVEY MAPS (1868, 1898 and modern)

By the time the first of these maps had been produced the wood had assumed its modern shape. Not only is the eastern section complete (and lying in the same position as now) but also the narrow strip of woodland running north to the present Club House is shown. In addition the hook-shaped wood to the east (which now sits on the fringe of Colquhoun Park) is also shown.

In both the modern and the 1898 map the present day footpath running through the middle of the wood is marked.


To
Andrew Houstoun Esq.
of Jordanhill:
This Map
is most humbly dedicated by
His most obedient.
& very humble Servant
Thomas Richardson.
RICHARDSON (1795)
References.
Miles Furlongs
Linthouse 4 . 0
Little Govan R. H. Rae 1 . 5
Mains 6 . 0
Mountvernon A. Buchanan 5 . 0
Millheugh 8 . 6
Muirend 4 . 0
Mavisbank 1 . 7
Merryflatts 4 . 1
Mosesfield 2 . 1
Mains Colin Douglass 8 . 0
Merriston 4 . 7
North Woodside 2 . 2
New Bank 2 . 5
Newton Montgomery 6 . 1
Newlands 2 . 1
Overnewton 2 . 0
Orchard 7 . 7
Piel 6 . 4
Plantation John Mair 2 . 0
Pollock (nether) 3 . 7
Pollock (over) Miss Pollock 7 . 4
Partfield 1 . 0
Possil 2 . 6
Petershill 1 . 6
Pinksten 1 . 5
Provanhall 5 . 3
Renfield John Campbell 1 . 2
Rindmuir 6 . 1
Ronns 6 . 1
Rosebank 1 . 5
Rosebank 1 . 5
NEW KILPATRICK Pt.
BALDERNOCK Pt.
RENFREW Pt.
Millgavie
Cotton Mill
Craighead
Windyhill
Windyelack
Fire Engine
Law
Bent
Snab
Gallosh
Craigback
Moor
Hutchison
Longfold
Castlehill
Grahams Dyke
Whitehill
Clydone
Broomfauld
Tomehead
Killbowie
Drumry
Duntochter
Dam
Garscadden
Chapelton
New Kilpatrick
Mosshead
Burnbrae
Baldernock Kirk
Barduie Loch
Kelvin Water
Parkhouse
Temple
Lockhill
Blackhill
Calderwell
Great Canal
Whitecrook
Yocker
Inchenan
Netherton
Kirkland
Renfield
Deanfield
Knock
Gallowhill
Meadowside
Hamiltonhill
Partick
Clyde River
Balmore
Kelvin Water


OS 1865
1:10560
Court Hill
Longlands
Castlehill
Thorn
Hutcheson Hill
North Hutcheson
South Hutcheson
Townhead
Broadholm
Garscadden Wood
Garscadden Mains
Dam
Iyer Lodge
Bedlub
Drumry
Garscadden House
Cockhill
Lochend
North Westerton
New Kilpatrick
Church
Beauvale
St Germains
Loch
THE CAUSEWAY
REMAINS OF THE WALL
SITE OF THE MILITARY WAY
CONSTRUCTED BY LOLLIUS URBICUS AD 140 ROMAN LEGIONS
ANTONINUS PIUS
STATION
Coal Pit
Well
Ironstone Pit
Bowling Green
Burial Ground

Moreover in both of the maps the path which skirts the top of the wood is described as being the site of the Military Way.

CONCLUSION

Old maps show that Garscadden Wood was in existence before 1750. Not until 150 - 200 years ago did it assume its present size, until then consisting only of its western section. By 1898 the wood's shape and paths were much as they are now.

HISTORICAL DOCUMENTS

Historical documents and estate papers provided much information about the old oaks at Cadzow. Unfortunately this is not the case for Garscadden Wood. This was simply an ordinary wood, an unremarkable place which does not feature in any of the old decriptions of the area. Only one historical mention of the wood has been found and I am grateful to Brian Skillen of the Glasgow Natural History Society for pointing it out to me:

> GLASGOW COURIER, Thursday April 7, 1808:
> "TO BE SOLD.
> A quantity of FINE WANDS, in Garscadden Wood, for Coal Works and Vitriol Works. The Wands for the Coal-Works are bound up in bundles, and are ready to be got at any time. Application to be made to Archibald Douglas of Burnbrae, New Kilpatrick."

Some conclusions can be drawn from this:

1. Garscadden Wood was in existence at the beginning of the 19th Century .
2. It was being exploited for its products ie. some form of woodsmanship existed
3. Wood suitable for "wands" grew in the wood - most commonly this would be willow or hazel coppice.

It could be argued that the advertisment does not specifically state that the wands were grown in the wood and so

the above concusions are invalid. Such an argument would not bear close scrutiny however as it is scarcely conceivable that the wood should have been transported from their site of growth to Garscadden.

The wood was part of the Garscadden Estate and as such one might expect some information relating to it in estate papers. In the 14th Century the Garscadden lands belonged to the Flemings of Biggar but after several changes of ownership they passed, in 1665, into the hands of the Colquhoun family (Buchanan, Smith and Mitchell 1878). The estate later became joined to the Killermont estate and was in the hands of the Campbell-Colquhouns until recent times. In the 1940s the estate was compulsorily purchased by the Corporation of Glasgow, Housing Department, and Drumchapel has since been built.

Unfortunately no estate papers have been found and it seems that they do not survive. Neither the National Register of Archives or Strathclyde Regional Archives (who hold the archives for Glasgow District Council) were able to locate any remaining papers from the estate.

Thus it is only the 1808 newspaper advertisment which provides any information about the wood and its past uses.

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THE OAKS OF GARSCADDEN WOOD

In much of Garscadden Wood oak is the dominant, canopy-forming tree. This is especially the case in the western part of the wood, the head of the "tadpole". Scattered throughout this part of the wood are a number of unusual oak trees. Each tree has several trunks, sprouting from a base or stool which may be in excess of 2m in diameter. These "oak rings" have been produced by coppicing, deliberate or accidental, and some of them may be of considerable age. 19 clear examples can be found (listed and described below). In addition to those listed there are others which may also be single trees with several trunks but they could not clearly be identified as such.

COPPICING

Cutting down a tree will very often fail to kill it. The roots are unaffected and so new shoots resprout. Coppicing is the name given to this practice and it has been common for many centuries. Since the root system is intact the new shoots regrow much more rapidly than a seedling starting growth at the

same time. Moreover the process can be repeated numerous times on the one tree with little loss of vigour.

Significantly, repeated coppicing of a tree results in its base (the stool) becoming larger and larger. Each successive crop of new coppice shoots is produced further and further out on the stool and giant stools exceeding 6m in diameter are known (Rackham 1980). Rackham suggests that these giant coppice stools are probably at least 1000 years old. None of the coppiced oaks in Garscadden Wood are of this magnitude but they are large enough to be quite old. Rackham (1980, page 15) states that oak stools 2m in diameter growing on a good site will seldom be less than 400 years old. As shown below some of the stools in Garscadden are greater than 2m in diameter and many are almost this size.

DESCRIPTION OF OAK RINGS IN GARSCADDEN WOOD

There are 19 stools in the wood. Labelling of these trees corresponds to the labelling of features on the map (page 134). "Gbh" stands for girth of a trunk measured at breast height. Stool dimensions are the widest diameter of the stool and the diameter at right angles to this.

OAK 1
6 trunks, only one of which is of any size (approx 10m in height). 2 outer trunks completely dead (cut at 0.5m above ground). 3 trunks damaged (vandalism), 2 of these have resprouted.
Gbh of live trunks = 107cm, 95cm, 88cm, 70cm.
Stool dimensions = 2.35m x 1.70m

OAK 2
3 trunks, 2 c.10m in height. Gbh = 110cm, 90cm. 1 trunk dead
Stool dimensions = 1.0m x 0.60m

OAK 3
8 trunks, all quite small. Largest c.3m in height, gbh = 64cm.
Stool dimensions = 2.20m x 1.64m

OAK 4
3 trunks
Height = 2m, max gbh = 80cm
Stool dimensions = 0.70m x 0.70m

OAK 5
2 trunks, 1 large, gbh = 113cm, height = 7m
1 small trunk which has been damaged. Gbh = 80cm
Stool dimensions = 1.50m x 0.50m

OAK 6
4 trunks, max gbh = 30cm
Max height = 5m
Stool dimensions = 1.3m x 0.40m

OAK 7
6 trunks
largest gbh = 70cm
Height = 7m
Stool dimensions = 1.30m x 0.35m

OAK 8
1 live trunk, gbh = 50cm. 3 very small trunks, all dead.
Stool dimensions = 0.80m x 0.40m

OAK 9
5 trunks
Max gbh = 70cm
Height = 6m
Stool dimensions = 1.30m x 0.50m

OAK 10 - Plate 3a
7 trunks
largest gbh = 70cm
height = 2.5m
Stool dimensions = 1.94m x 1.50m

OAK 11
Actually growing on earthwork at southernmost part of wood
4 trunks are present although they may not all be from the same individual. 3 trunks are obviously joined to same stool, the fourth may or may not be a separate individual. Total diameter of the stool if all 4 trunks do actually arise from the one stool = 2.70m; diameter of stool if it only consists of the 3 trunks = 1.90.
Height = 4m

OAK 12
2 living and 2 dead stumps 0.80m apart (these may be 2 separate trees).
Height = 4m
Gbh = 40cm each

OAK 13
1 large trunk plus 2 smaller stumps, barely alive.
Whole tree has been hacked repeatedly and has since branched repeatedly.
Stool dimensions = 1.50m x 0.75m

OAK 14
2 trunks,each c.3m in height, both highly branched as a result of repeated cutting
Stool dimensions = 1.0m x 0.50m

OAK 15
2 trunks. 1 trunk very damaged, branched into 3 smaller trunks. Other trunk 1.80m away, gbh = 20cm

OAK 16
4 trunks plus 1 dead stump
Height = 2.5m - 3.0m
Gbh all less than 30 cm
Stool dimensions = 1.0m x 1.2m

OAK 17
10 trunks , all small. Height = 3m. Gbh of largest = 35cm, 4 trunks c. 30cm, others all less than this.
Stool dimensions = 1.11m x 1.06m.

OAK 18
6 trunks
gbh of largest = 30cm
Stool dimensions = 1.10m x 0.30 cm

OAK 19
3 trunks, all small as a result of repeated vandalism (all less than 30cm)
Height = 3m
Stool dimensions = 1.50m x 1.10m

IDENTIFYING THE OAK RINGS

As stated these 19 trees were considered to be clear examples of oak rings. However there is always the possibility that in some cases the trunks identified as belonging to the same tree are in fact 2 or more trees growing very close together. Equally the opposite possibilty exists - trunks which were too widely spaced were regarded as probably being different individuals but this may not be the case.

The decision about which trees to include and which to classify as separate individuals is ultimately a subjective one. It is entirely possible for two trunks to be of the same individual and yet to be so widely spaced that there is no obvious physical connection between the two (Rackham 1980). Obviously if several shoots are from the same individual one would expect characteristics to be similar eg. in growth habit, leaf shape and fruiting characteristics. Yet variation could be present because of environmental differences and so care must be exercised.

Even where physical connections between trunks could be discerned there exists the danger of misinterpretation. Separate individuals are known to anatamose or join together. Again physical characteristics need to be considered for signs

of similarity. The only conclusive proof would be DNA analysis but this was outwith the scope of my research.

The decisions were thus based upon a clear pattern of growth where physical connections were visible or, when absent, there was the appearance of the trunks emerging from a common point. As stated general similarity of characteristics was taken as being significant.

It is thus possible that some of the oak rings identified are in fact more than one tree and not the result of coppicing at all. And it is almost certain that there are additional oak rings in the wood which have not been listed above but which were not sufficiently certain in nature to be classified as such.

TAXONOMY OF THE OAKS IN GARSCADDEN WOOD

As already discussed correctly identifying oaks to species level can prove difficult. A cursory glance suggested that the Garscadden oaks were not Q.petraea but they did not seem to be pure Q.robur and a more detailed analysis was carried out.

Garscadden Wood

In August 1992 oak leaves were collected from fourteen trees and these were then analysed. For only two of the trees was it possible to collect the infructescences, 1992 being a year in which the oaks in Garscadden almost completely failed to fruit. The precise method of sampling leaves for analysis outlined by Cousens (see page 23) was considered unnecessarily time-consuming, as was the more detailed of the methods of analysis carried out on the Cadzow oaks. The more subjective method was used (see page 22).

Samples were collected from 8 of the oak rings and from 6 of the maiden oaks. They were than analysed for 6 different features, being given a score of 1, 3 or 2 depending on whether they demonstrated features of Q.robur, Q. petraea or intermediate characteristics respectively. The results are given over:

NB. Since fruiting characteristics could not be used there are only 6, instead of 8, features analysed. Theoretical scores for the different species are thus different.

TABLE OF TREES ANALYSED FOR CHARACTERISTICS TYPICAL OF **Q.robur**, **Q.petraea** and intermediates

TREE	Petiole	Shape	Lobing	Lobe no.	Auricles	Leaf hairs	**HYBRID INDEX**
2	1	1	3	2	1	1/2	9.5
3	3	2	3	1/2	1	3	13.5
4	1	1	2	1/2	1/2	1	8.0
5	2	1	3	1/2/3	3	1/2	12.5
6	1	1	1	1	1	1	6.0
10	1	2	2	1	1	1	8.0
16	1	1	1	1/2	1	1	5.5
17	1	1/2	2	1	1	1	7.5
						Average =	8.8
maidens							
M1	2	1	3	2	3	1	12.0
M2	1	2/3	2	2	2	1	10.5
M3	1	1	2	1	2	1	9.0
M4	1	1	1	1	1	1	6.0
M5	1	1	1	1	1	1	6.0
M6	1	1	2	1	2	1	8.0
						Average =	8.6
						OVERALL AVERAGE =	8.7

Key: 1 - characteristic of **Q.robur**
2 - characteristic of **Q.petraea**
3 - intermediate characteristic
(Where different leaves on the tree show characteristics of more than one type more than one score is given for that character.)

For full explanation of scoring see page 21.

MINIMUM SCORE ie. theoretical score for **Q.robur** = 6
MAXIMUM SCORE ie. theoretical score for **Q.petraea** = 18
INTERMEDIATE SCORE ie. theoretical hybrid = 12

INTERPRETATION OF RESULTS

The trees are clearly not **Q.petraea.** As stated this would result in a theoretical score of 18. The highest score obtained was 13.5, this particular tree therefore being closer to **Q.petraea** than **Q.robur.** This is not the norm, the average Hybrid Index being 8.7 which is closer to **Q.robur.**

Comparing the oak rings and the maidens the following can be seen:

- the range for the oak rings is 6.0 to 13.5 and the average score was 8.8.
- the range for the maiden oaks in very similar: from 6.0 to 12.0 with an average for these trees of 8.6.
- a simple t-test confirmed that there was no significant difference between these two samples.

As with the Cadzow oaks the trees are not simple hybrids - this would produce a score of 12.0. Some introgression seems likely, especially as they are closer to Q.robur than the Cadzow oaks (they would have a relative value of 11.6 compared with the Cadzow oaks' hybrid index of 12.7 (see page 28).

The implication therefore is that the oak rings and the maidens are the result of hybrids which have then introgressed with **Q.robur.** Comparing the two sets of trees it seems that

they are very similar in nature and hence possibly in origin. It is entirely possible that the more recent oaks are the offspring of the older trees, whether through natural regeneration or through deliberate planting of acorns.

AGE OF THE OAKS

How old are these trees? The age of the maidens is something which can be ascertained relatively easily. As described already (page 65) it is possible to count the annual rings of a living tree by removing a core from the trunk. When carried out on these oaks it was found that there was a narrow range of ages. The youngest of the trees was found to be 108 years old while the oldest was 123 years old. Most seemed to be around 120 years old. Confirmation of these ring counts came from cut stumps where the annual rings are most easily seen.

This suggests that these trees were either planted, or regenerated naturally following removal of the existing canopy, around the year 1870. The similarity in tree size and their equal spacing suggests that the early growth of the trees was certainly manipulated by man ie. if natural regeneration of an existing crop of acorns was the method used to restock the wood then the saplings must have been carefully thinned to give the present distribution of trees.

Establishing an age for the oak rings is obviously a much more dificult task. Finding the age of the existing trunks is possible but this only provides information on when the last cut of these trees occurred. As stated already the actual stool of the tree may of some antiquity, the larger the stool the older it is likely to be, some of the trees probably in excess of 400 years old.

A few of the trunks of these oak rings are almost identical in size and girth to the maidens and one might then assume them to be the same age. This would potentially be from resprouting when the previous canopy was cut and the maidens were planted. However similar sized trunks, one grown from seed and one grown from a coppice stool, are unlikely to be similar in age as the coppice stool's root system is already present and should therefore result in more rapid growth. This is shown by one of the multi-trunked oaks (number 8) which has a trunk nearly as tall as the canopy of the maidens and yet coring it showed that it is only 75 years old.

If these oak rings are a similar size to the maidens they must have been cut more recently, in the early part of this century, when the maidens were c.50 years old. This could have been because they were overtopping the crop of maidens although one would expect such management to have been carried out when the trees were younger.

A more likely explanation is that these trees were the only ones large enough to be harvested as a crop. Seventy five years ago (1918) was certainly a time when timber was in great demand and the war might have been responsible for shaping this aspect of the wood.

Despite this, the majority of the oak rings are much more variable in their size, and hence age. This probably reflects nothing more than the time since the last act of vandalism was practised on them. The ages of all the trunks in the lower part of the wood is probably no greater than 30 years and it is also significantly here that there is the most obvious signs of burning and vandalism. Yet the trees are surviving, the oak rings seeming more resistant to the vandalism than young saplings in this area.

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EARTHWORKS

Garscadden Wood is criss-crossed by a confusing array of ditches, banks and paths and some of these may be very significant. As previously described some ditches are very obvious just outside the wood, running away to the northeast across Bearsden Golf Course. They are almost certainly ridge-and-furrow earthworks - the typically round-topped parallel undulations produced by ancient ploughing. They are clearly marked on Roy's map from 1750.

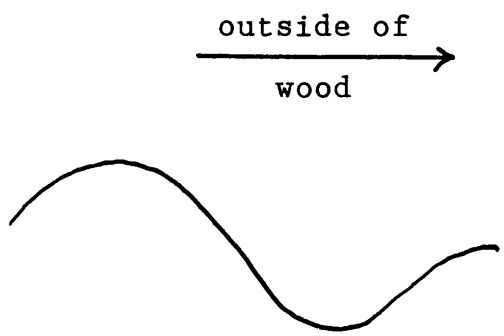
Old earthworks in a wood are an important source of information about its past. As Rackham (1975, page 19) states:

> "We do not plough our woods and seldom dig in them. They tend to preserve all the surface features that have been on the site since it became wooded. Some of these features are related to the wood as such; others may remain from former land use."

Evidence of past cultivation in a wood, such as ridge-and-furrow, will imply that the wood is secondary in nature. Other features, such as the remains of woodbanks or other enclosures may indicate that a wood is very old. Rackham's studies of

the ancient woods of southeast England (eg Rackham 1975) have shown that some form of wood boundary was extremely common in medieval times and there are records of such from the 12th Century. Although evidence of 19th Century woodbank construction can be found (Cruikshank 1830) these structures are normally medieval in origin and so provide evidence of a long-established wood.

Typically a wood boundary would consist of a bank and ditch with either a fence or a hedge on the top of this. The particular shape of a woodbank is often related to its age (Rackham 1975). He shows that medieval woodbanks in Essex, Suffolk and other southeastern counties are typically very wide and their total width may reach 10m. They normally consist of an outer ditch up to 1m in depth with a bank inside it of 0.5-1.5m. More recent woodbanks are progressively narrower and more acute in profile. In addition the actual line of the boundary tends to be straighter with fewer twists and bends if the enclosure is relatively recent.



Rackham's studies of woods in southern England have not been mirrored by studies of Scottish lowland woods and it may be that there are significant differences in wood boundaries

here. In particular the greater abundance of stone may mean that the boundaries are of different construction.

That there is an abundance of earthworks in Garscadden Wood is without doubt. Understanding and interpreting them initially appeared problematic, such is the confusing array of criss-crossing ditches, banks and paths. It was decided that it would be valuable to have an accurate map of this area at a sufficiently detailed scale to record individual trees of interest and the maze of earthworks. Accordingly the Association of Certified Field Archaeologists (Glasgow University) were contacted and they agreed to carry out a survey of the western part of the wood ie. the head of the "tadpole". This was a labour-intensive task requiring 17 individuals over 3 full days and I am greatly indebted to them for the professional surveying of the wood which was carried out. The map produced by their survey is enclosed (over).

DESCRIPTION OF EARTHWORKS IN GARSCADDEN WOOD

For ease of description these can be categorised as follows:

1) Boundary enclosures (map features A,B,C,D and F).
2) Regular ditches near North edge of wood (map feature G).
3) "Site of Military Way" (map feature E).

GARSCADDEN WOOD N.S.527 723

arsden and Milngavie District

y:

fallen oak with regeneration. (numbered I-VII)

coppiced oak. (numbered 1-19)

ootpath.

drainage or rig.

pylon

A - F : boundary enclosures

eyed March 1992.

LE 1:1000.

50m.

m.n.

ACFA

e of 19c. pit wagon way

BEARSDEN GOLF COURSE

ANTONINE MILITARY WAY

spring

spring

edge of tree cover

edge of tree cover

cleared area

cleared and burned area

cleared area

DRUMMORE ROAD

DRUMCHAPEL

A

B

C

D

E

F

G

I

II

III

IV

V

VI

VII

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

1) BOUNDARY ENCLOSURES

The present total perimeter of the wood is not marked by any obvious earthwork such as a medieval woodbank. But this is not to say that no such structures are to be found anywhere in the wood. Demarcating the northern edge of the wood, particularly at its western end, there is a low bank (map feature E). This is topped by a line of beech trees of perhaps 150 years age. The total width of the bank and ditch is only 6m making this relatively narrow in comparison with the majority of those described by Rackham. He states (Rackham 1976, page 115) that early earthworks are usually at least 30ft (approx 10m) wide. The total height of the bank at Garscadden is never greater than 1m.

Running roughly north-south through the wood near the middle, and thereby cutting off the head of the tadpole, is another, more substantial enclosure (feature C on map). Masked by a dense growth of brambles and bracken and partially collapsed in places it is not obvious. Nonetheless it is quite substantial, consisting partly of stone and attaining a height of 1.0m in parts. There is evidence of a shallow ditch to the east side ie. towards the tail of the tadpole.

A boundary is present in fragments along the southern edge of the wood (map feature B). No sign of it can be found

in the eastern half of the wood but there are small fragments at the south western corner. In the area of the trees marked 11 - 19 on the map it consists of a bank sloping away to to the south towards the housing of Drumchapel. On the inside of the wood there is a small ditch, the significance of which is unclear. East and west of this the bank disappears, this seemingly because of more recent disturbance (see page 171). Near the south western corner there is a significant area of bank, some 80m long and reaching a height of 1.5m. An internal ditch is present in places. The boundary itself consists of a turf and stone bank.

In summary the western part of the wood (the head of the "tadpole") is partially enclosed on its southern edge by a substantial woodbank and by a much smaller one on its northern edge. In addition a ditch and bank running from north to south marks the junction between the head and the tail of the "tadpole". A 3 sided enclosure is thus apparent.

What of the western boundary of the wood? It is now marked by a feature marked on some maps as the "Site of the Military Way" (see page 140) but as will be argued the original woodbank is within the present limits of the wood.

A clear ditch and gully runs down the slope within the wood, roughly north to south, (map feature A) and this is

discernibly continuous with another ditch and gully running east to west (labelled D). I am convinced that these are the original western and northern boundaries of the wood, those now to the outside of them, E and F respectively, being more recent. Their physical dimensions and charactersitics are entirely consistent with an origin as a woodbank.

The ditch and bank marked A has the following measurements: it is about 4m wide with a total depth of 1.0m in most places but reaching a depth of 1.5m in places. On the inner side of the ditch there is a low mound. In places the ditch has been fortified with stone. It now serves as a drainage gully for the upper parts of the wood and it is likely that at some stage in the recent past it has been straightened and perhaps cleared of silt. Nonetheless it is still highly typical of an ancient woodbank.

Bank D is less clear, a path now running through the wood on the northern side. However it is a substantial feature attaining a depth of 1.0m in places. As shown on the map it does not run clearly as far as the eastern boundary, the drainage ditches marked G perhaps interfering with its previous course.

If this interpretation is correct, and the evidence from other earthworks (see below) and the botanical nature of the

wood (page 146) confirm this, then it implies that there was an original core to the wood, smaller even than the existing western part of the wood. The surrounding area of woodland would only then have become woodland and been incorporated into the present day wood at some later stage. This is shown in the map (page 149).

2. DITCHES INSIDE THE WOOD

Lying just to the north of this ancient inner core area is a whole system of regularly spaced ditches, shown on the map as feature G. They run up and down the slope which, in this part of the wood, is quite gentle. Their orientation is thus roughly north-south. They are regular, parallel furrows about 1m wide, 0.25m deep and about 6m apart. All ditches have a definite endpoint at their southern end, either being cut across by a small bank or emptying into a drainage gulley. The easternmost ditches end in a deep drainage gulley which runs across and down the slope. It then debouches into a deeper gully running south down the slope, this latter gully continuing the line of the eastern boundary bank. The ditches in the central part of the wood are transected by 2 large drainage gullies which run east-west across the slope while those further east end in a low bank.

The presence of these regular ditches in the wood is very significant. This is an area of some of the tallest oak trees in the wood and they clearly stand on top of these ditches. It is evident that the ditches predate the trees since if the trees were already standing there at the time the ditches were cut then there would be some sign of the ditches skirting around them. This is not the case. The implication is that this part of the wood is secondary in nature ie. that at some time there were no trees at all and that the ditches were then cut.

It is less apparent why these ditches should have been cut. It has already been stated that just outside the wood there are clear remains of ridge-and-furrow cultivation and it is possible that these ditches are also the remains of such ancient cultivation. In some respects these ditches have a more modern appearance, their straight edges and clarity sugesting that they are more recent. It is quite conceivable that the ditches were cut much more recently perhaps for drainage when planting trees. It has already been stated that these trees, although quite large, are only c.120 years old and the drainage ditches could well be the same age.

Significantly, they do not encroach upon the area identified as the ancient area, with the possible exception of those at the eastern end where the exact limits of the ancient

area are unclear. The presence of such ditches within this part of the wood would show that it was not primary woodland and therefore would not be ancient.

3. "SITE OF THE MILITARY WAY" (map feature **E**)

As already noted the OS maps from 1865 and 1898 show that the military way associated with the Antonine Wall skirts the north-western end of the wood and may even form its western boundary. Typically this road which ran along the southern side of the wall was separated from it by a distance of no more than 16-18 feet (Robertson 1990). However at this point it appears that there was a much more considerable separation of the two. Robertson states (p92):

> "At Bearsden the Military Way seems to have sent off a bypass whose line is now roughly continued by Upper Thorn Road and by a path across Bearsden Golf Course."

This is clearly shown on the map of the Wall and the Military Way by Macdonald (1911). His map further shows it continuing, as marked on the Ordnance Survey maps, around the edge of the wood. Moreover it appears as if the course of the Way is such that it makes a detour around the wood. Is this because it is skirting around a wood which was already in existence at the time the Way was built?

The course of the Military Way is still clear as it crosses Bearsden Golf Course, just to the north-east of the wood. It is continuous with Thorn Road and consists of a cambered mound with drainage ditches on either side, cutting right across the ridge-and-furrow. It is topped by the remains of a hawthorn hedge. At its eastern end, where it reaches the edge of the wood, its course suddenly becomes much less clear. In only one place is there an obvious feature which corresponds with that marked on the map.

This is a deep ditch marked on the map as feature **E.** A detailed description has been compiled by the ACFA survey (see page 133) and the following is an extract from this (Marshall 1992):

> "A ditch separated by two bounding walls, it runs for 130m in a NNE - SSW direction and forms the West boundary of the wood.... The ditch is 8m wide between the banks, narrowing to 2m at the ditch bed, although considerable silting and accumulation of soil and tumble obscures the true dimensions of the feature. The ditch depth is thus at least 1.5m, ... the silting of the feature being encouraged by the deliberate convergence of the opposing walls at a point 50m above the west entrance to the wood."

A detailed description of the walls which form the sides of the ditch can also be found in this paper. In summary, they

consist of at least 6 courses of "revetted shaped freestone", topped in places by a low bank.

If this is in fact the site of the Military Way, and it is outwith the scope of this research to investigate the validity of such a claim, it has a much more modern appearance than would a Roman walkway. Moreover the nature of the feature, a ditch as opposed to a causeway of any sort, suggests that industrial age alterations were made and that what is now visible is highly altered.

Exactly why the Way followed this route is unclear but it would be unwise to state that this was to skirt a wood which predated it. It is probably more likely that the wood was planted up to an existing boundary ie. the line of the Way. The course of the Way would have been determined by numerous factors and the existence of a wood is unlikely to have been the primary consideration.

CONCLUSIONS

The presence of various earthworks provides much information about the wood. There are indications that there is an inner core, forming the majority of the head of the "tadpole", and that around this there are more recently incorporated areas. The full implications of this can only be seen when the all the various features of the wood are considered together. This is the topic of the next chapter.

Plate 5a
Coppiced oak
(No.10 on map).
Stool diameter = 1.94m

Plate 5b
Maiden oaks in
ancient core of wood.
(Ditch marking
boundary visible in
foreground).

Plate 6a
Horizontal oak
(No V on map).
Upright shoots *c.*20-
25 years old.

Plate 6b
Sycamore stump in eastern
part of Garscadden Wood.
New shoots *c.*2m, age 2
years.

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HOW OLD IS GARSCADDEN WOOD?

On the basis of the information discussed in the previous chapters some conclusions can now be drawn about the age of the different parts of the wood. This information is summarised in the table on page 148. Definite signs of antiquity are present: the wood is marked clearly on old maps, some very old trees are present and some of the earthworks which remain in the wood are consistent with an old managed wood.

As argued the presence of the wood on Roy's map from 1750 is highly significant and the fact that it is not shown on Timothy Pont's earlier map was not taken to indicate that the wood was not present then. There is clear evidence that trees have been standing on the site for at least 400 years without interruption - ancient oak rings with a likely age of at least 400 years survive there today. It is true that they could be isolated individuals, rather than surviving fragments of a wood. However in the presence of so much other evidence of there having been a wood there this explanation can be discounted.

What then of the presence of surface features in the wood, indicating that it is secondary in parts ie. remains of possible ridge-and-furrow? The presence of this and the presence of the ancient woodland earthworks ie. the boundaries and gullies, can easily be reconciled if one allows for changes in the size and shape of the wood with the passage of time. The indications are that there is an inner core of the wood which contains all the ancient features and that the outer parts of the wood are more recent additions. This is shown on the annotated map (page 149).

It has already been suggested that the "tail" of the tadpole is of much more recent origin than the "head" - it is not shown on any of the old maps and there are no old trees or ancient earthworks in this area. But as seen the "head" of the tadpole is not homogeneous in nature and what constitutes the "head" region now does not correspond exactly with that marked on the early maps.

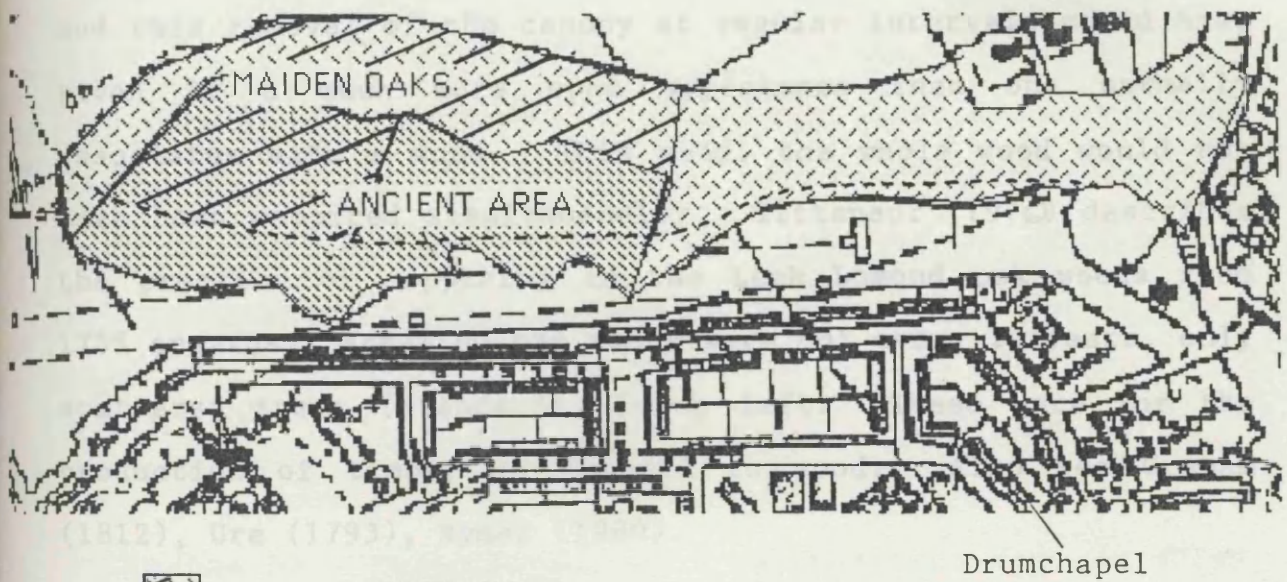
All the old trees are in the inner core of the wood (see map). None of the ridge-and-furrow is in this area. A boundary of some description can be identified enclosing most of this area. Paradoxically this core area, which has been identified as being woodland for the longest time, is now the least wood-like. The rest of the wood has, for the most part, a continuous canopy. In contrast much of the ancient core of

PROBABLE HISTORY OF GARSCADDEN WOOD

pre 1600	the present multitrunked oaks began life in primeaval forest (?), some parts of the wood probably already under cultivation
1700s, 1800s	coppicing practised in ancient inner core of wood
early 19th Century	"tail" added to the wood (before 1859)
late 19th Century	planting of maiden oaks in and around ancient inner core of wood
1940s	Garscadden Estate passes into ownership of Glasgow District Council and nearby Drumchapel built thereafter
1947	large cleared areas visible in wood in aerial photographs
1965	aerial photographs show little recolonisation of clearings, some encroachment from Drumchapel into southern fringes of wood
1965-1994	few largescale changes although paths are being cut and asphalted through the wood to encourage local assess

GARSCADDEN WOOD:

Head of "tadpole"
ie. area studied in depth



= MAIDEN OAKS

= ANCIENT AREA

the wood is without a canopy and the vegetation is largely grasses and shrubs.

Yet strange as this seems to the modern eye there are some similarities between its present state and its appearance in the past. Coppicing was clearly practised in Garscadden Wood and this removal of the canopy at regular intervals would have given it a much more open appearance than one normally associates with a wood. This said, the whole wood would not have been coppiced simultaneoulsy. Tittensor (1970) describes the practice of coppicing in the Loch Lomond oak woods from 1735 onwards. Areas of the woods were cut every 24 years, only scattered trees (standards) being left. These were for the production of timber as opposed to wood. Also see Graham (1812), Ure (1793), Rymer (1980).

Naismith (1798), describing woodsmanship in the county of Clydesdale states:

> "The copse woods are sometimes cut once in 25 or 26 years, but are more frequently allowed to grow 30 years."

He states that extensive woods were divided into separate areas called hags, each of which was 3 - 7 acres in area. Within each area there would be twenty or twentyfive select trees, "called reserves or writters" which would be left to produce timber of different sizes.

Coppicing was certainly practised in Garscadden Wood, as the surviving coppice stools testify. The ancient core of the wood measures c.9ha or 22 acres and so would have consisted of at least 3 to 4 hags, if the methods described above were used there.

Documentary evidence of coppicing, although sparse, does exist (page 115). And a managed wood in which coppicing was occurring would normally have been enclosed in some way to exclude grazing animals. Fragments of such a boundary have been identified.

The conclusion then is that this inner core is an area which has been in existence as a managed wood for centuries. As argued later the likely implication is that there has been continuous woodland cover on this site since the Ice Age.

What then of the other parts of the wood? Surrounding land now in the wood may at one stage have been cleared of its natural tree cover and cultivated. But more recently it has been incorporated back into the wood. The age of the maiden trees (120 years old) found here and the inclusion of these areas in late 19th Century maps (but not earlier ones) suggest that this expansion of the wood occurred last century.

It is perhaps highly significant that the planted trees in this area are c. 120 years old. The first time that the enlarged wood appears on a map is 1865, if one discounts the rather ambiguous 1795 map by Richardson. Could the planting of the trees have occurred at the time the wood was enlarged?

Certainly a slight discrepancy exists - of the trees cored the oldest was found to be 123 years old, suggesting a planting date of 1869. Some of the maidens could be older than this taking their origin back to the early 1860s, so being present when this map was published. However the surveying occurred prior to the publication (1859) and it is unlikely that any of the present trees were growing then. The date of extending the wood to its modern limits must remain unknown and could have occurred any time during the early 19th Century or before. It was in existence when the 1859 Ordnance Survey was carried out. Shortly after this the trees must have been cut and a new crop either sown or allowed to regenerate naturally. These now form the present canopy of the wood in places.

Is any part of Garscadden Wood "ancient"? As discussed on page 81 a wood will normally be classified as ancient if it can be shown that it has been in existence since 1700 (Rackham) or since 1600 (Peterken). The inner core area appears to satisfy even the more stringent of these criteria since the trees are surely in excess of 400 years in age and this implies growth

from the 16th Century onwards. Also discussed in this earlier chapter is the notion that an ancient wood will nearly always be of natural origin rather than being planted. This seems likely for this part of Garscadden Wood and it may therefore represent a vestige of the country's original forest cover. As with nearly all such cases it will however be virtually impossible to prove that this is the case.

What Garscadden Wood certainly is not is natural. Even the ancient parts have been managed for centuries and some indication has already been given of the obvious signs of human activity in the wood now. These deserve a more detailed analysis.

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ECOLOGY OF GARSCADDEN WOOD

The previous chapters have established that the wood is of considerable historical interest. Yet many aspects of its present ecology merit consideration:

A. Oak regeneration
B. Horizontal oaks
C. Flora of Garscadden Wood
D. Effect of building Drumchapel

A. OAK REGENERATION

Garscadden Wood is, in some areas, basically an oak wood and yet there is reason to doubt whether this will remain so in the future. This is because there is a very noticeable lack of young oak trees growing up beneath the oak canopy. Such a phenomenon is very widespread eg. Shaw (1974, page 162) states;

"It is widely assumed by foresters and ecologists alike,

that natural regeneration of both our native oaks is either failing, or is severely deficient".

This was recorded by Watt (1919) and has been the cause of much research since eg. Mellanby (1968), Carlisle, Brown and White (1966), Jarvis (1964), Ovington and MacRae (1960), Piggot (1983) amongst many others. Shaw (1974) surveys much of the literature up to this time and he summarises the situation as follows. In most "oak woods" ie. where oak is the dominant tree, there may be a noticeable lack of saplings and young oak trees. Yet oak has normally been thought of as a woodland species and so one might expect to find it regenerating freely and establishing itself in such woods.

That oak very often does not replace itself effectively beneath its own canopy is beyond doubt. This is certainly the case in Garscadden Wood. In exactly the fashion described by Shaw there is a noticeable lack of oak saplings beneath oak canopy. But this is not to say that no oak **regeneration** is occurring in the wood. Very young trees of up to 0.5m in height are common. Deducing the age of these trees is not always simple as the bud scars demarking the end of each year's growth can easily be confused with scars at the base of lammas growth. Nonetheless it seems as if they are always less than 10 years old where they are found beneath an oak canopy. In contrast birch, holly and hazel saplings are common.

Elsewhere, in the more open parts of the wood, regeneration and establishment are much more successful. Indeed it is as successful as that of any species. Few trees are growing in the most southerly parts of the wood (nearest to Drumchapel), evidently as a result of the repeated fire-raising. But further into the wood oak is regenerating as effectively as any other species.

The failure of oak to regenerate and establish itself effectively beneath its own canopy has, as stated, been the subject of much research and discussion. Shaw identifies the growth and survival of the seedling as the critical stage in the successful reproduction of the oak. Acorns are regularly produced, if not in every year then every 6 or 7 years (Shaw 1974, Jones 1959). 1992 was not a good acorn year in Garscadden Wood with many of the adult trees failing to produce any acorns observable from the ground at all. However in 1991 many more acorns were produced and so poor regeneration and establishment is not due to a shortage here. Interestingly there seem to be very local factors affecting this sporadic fruiting as both years resulted in large crops of acorns at Cadzow which is a distance of less than 15 miles away.

Acorns then are normally produced in sufficient numbers to result in a copious understory of oak trees. On occasion they are widely eaten by small mammals and birds but sufficient

numbers will normally survive to result in a population of seedlings. Mellanby (1968) states that the species of animal which destroy most acorns by feeding on them also appear to be the species most important in regeneration. Certainly seedlings are present in Garscadden Wood, even beneath other oaks, proving that acorns are escaping predation. It is the subsequent survival of these seedlings, and then their growth into trees which are then capable of reproduction themselves, which seems to be the weak link in the chain.

One explanation for this would be that they are simply intolerant of the shade of their parents. This is an argument refuted by Shaw on the basis of experiments by Jarvis (1964a) and others. Jarvis shows that experimentally grown seedlings (albeit one year old individuals only) are capable of significant growth at only 10% of full daylight and optimum light intensity is usually around 30% full daylight. The amount of light reaching the floor of an oak wood will commonly be in excess of this and this will certainly be the case in Garscadden Wood with its relatively open canopy. Jarvis concludes that other factors must be responsible for the poor growth of oak seedlings in oak woods.

One such factor could be root competition. Experiments investigating root competition between Deschampsia flexuosa and oak trees have shown that root exudates from the former have a

deleterious effect on oak seedling growth (Jarvis 1964b). Ovington and MacRae (1960) propose a different, although connected explanation. Experiments with boxed seedlings of Q.petraea showed that the degree of shading was more significant in controlling seedling growth than the nutrient status of the soil. They suggest that acorn germination and initial seedling growth can occur even in some degree of shade because of the substantial food reserves in the large seed. The problems then arise when leaves are shed at the end of the growing season. They argue that the loss of nutrients which occurs with each successive leaf loss is something which a **shaded** seedling is unable to tolerate.

They do not attempt to explain the link between lack of light and an inability to cope with this loss of nutrients. A possible mechanism could lie in the fact that the most shaded seedlings had the lowest root:shoot ratio in their experients (as one would expect - a form of etiolation occurring) and their roots may therefore be unable to carry out effective "nutrient mining". This could simply be because the root system is not extensive enough to capture enough of the available nutrients, all assimilate being required for the elongation of the stem. Alternatively the effect could be manifest through the plant's inability to sustain its mycorrhizal partner.

If the shade effect is, as argued from these results, manifest primarily through the inability of a shaded seedling to obtain nutrients, then one would expect to see oak woodland replacing itself much more effectively on nutrient rich soils. I am not aware of any evidence to show that this is the case. Thus, while this may be a contributary factor, it would appear that it is not the whole explanation. An analysis of the soil from Garscadden Wood could prove constructive.

Shaw (1974) proposes that, as argued above, the nutrient status is important but that in addition one must assess the biotic pressures on the seedlings. Browsing by herbivores will have a very serious effect on their survival. Yet in Garscadden Wood the amount of browsing is clearly limited. No browse line is visible in the vegetation at all - this can be a very marked and visible point below which the growth of shoots is much less luxuriant than above. I have seen woods where large hebivores are undoubtedly present and affecting the vegetation.

The oak woods of Inchcailloch Island are a clear example of this and a browse line is very evident probably due to the presence of fallow deer. In one particularly clear case an ivy growing up and around an oak trunk is entirely devoid of leaves below a height of c.2m. At this point there is a vertical line around the trunk and there is a luxuriant growth of leaves

above. Elsewhere on the island one can see the lower branches of trees with only a scant cover of leaves below a clear-cut height. No such evidence of large herbivore grazing exists in Garscadden Wood.

The implication is that there are virtually no large herbivores such as sheep or deer present. The proximity of the Drumchapel housing makes this seem quite plausible. Moreover there is no evidence of rabbit burrows or droppings and the numbers of these animals do not appear to be high. Smaller herbivores (mice and voles) would certainly have passed unnoticed by me.

Shaw suggests that another form of biotic pressure on the seedlings has often been overlooked - the effect of defoliating caterpillars. He argues that the effect of these invertebrates will be most pronounced beneath an existing oak canopy as the latter is the source of the defoliators of the seedlings. These fall off the parent plants and then strip the seedlings of their leaves. Having little in the way of food reserves these seedlings cannot then survive.

Rackham (1980) concurs with the notion that any form of damage to a shaded oakling will perhaps be fatal. In contrast an individual growing in full sunlight will be able to survive the damage. This is because it is likely to have larger food

reserves and will obviously be able to make up for lost assimilate more rapidly. However he points out that the regeneration of oak in past centuries was much more certain and reliable than now and so one must look for some influencing factor that has changed in the recent past.

He suggests two further factors which must be considered. An alternative biotic pressure on seedlings comes from the oak mildew fungus Microsphaera alphitoides, now common on European oaks. Rackham states that before 1908 it is only recorded as being a problem in North American forests and not in Europe. This is certainly a factor that would account for the change in the regeneration pattern.

I have observed both defoliation by caterpillars and damage by mildew in Garscadden Wood although in both cases it was the mature trees rather than the seedlings which appear to be most affected. Both factors could be important and extensive studies of them would be profitable.

Rackham argues that there is another significant difference between the oak woods of old and of the present. This is in the methods which have been used by man in their management. Rackham (1980) argues that, historically, more regeneration occured through coppicing than through planting. Seedling establishment and growth was then not so essential to the

continuing presence of oak in the wood. In addition the more regular opening up of the canopy than is practised now aided the establishment of seedlings which were present. It may have required more than one coppice cycle before a particular seedling was sufficiently released from the shade of others to establish itself fully but even this amount of canopy opening is not present now. This is certainly something which has changed in Garscadden Wood - no real management having been practised for more than a century.

Two final and very important issues remain to be considered:

1. Should one really expect to find oak regenerating beneath itself?
2. Should one really expect the survival of large numbers of seedlings?

In answer to the first of these issues Shaw suggests that there has been some considerable misemphasis here. Oak should not be considered as a climax species in the sense that Acer saccharum is in N. America. "Neither as a seedling or as an adult tree is oak really a shade-bearer." Oak does regenerate embarrassingly well (Rackham) in the right conditions but this is rarely beneath other oak trees. He states that it is more of a pioneer species than often supposed and will readily colonise new areas. Expecting it to regenerate beneath an existing canopy is thus misguided. The nature of Garscadden

Wood with its large clearings and open areas would therefore be excellent for oak regeneration if the fires and other acts of vandalism were prevented. It is noticeable that around the fringes of the wood away from the houses oak is colonising open areas.

The other misconception is that the great loss of acorns and then seedlings jeopardises the future survival of the oak in oak woods. It is true that one does not find a mosaic of age classes within an oakwood and that there may be an almost complete absence of trees between the ages of 2 and 50 years old. But the adult trees do not need to have a whole cohort of individuals growing up to replace them. Each tree need only be replaced by one seedling. As Rackham succintly states: the significant factor is not that only 1 acorn in 10 000 000 survives (which is what happens now). If the survival rate were any higher then the world would soon be taken over by oak trees!

While slightly facetious the point being made here is valid - that for every tree only one individual need survive to replace it. Set against this argument must be a consideration of the relative survival rates of different species competing with each other to form the new canopy. If, as at Garscadden, other species are more effective than oak at replacing themselves it will lose its dominance of the canopy.

Will Garscadden remain an oak wood? Is oak regeneration sufficient? If old management methods were re-introduced then the answer would certainly be yes. Coppicing the present maidens would ensure a new crop of oaks to replace them. Perversely the vandalism of parts of the ancient core of the wood may have had the same effect since the wood is in effect being coppiced accidentally.

But if the wood is left unmananged then the dominance of the canopy by the oaks will not be indefinite. They might colonise the open areas of the wood, especially in view of the plentiful supply of acorns form the maidens. This will largely depend on the degree of burning in the future, as discussed later. But elsewhere oak may gradually be replaced by other trees such as sycamore growing up and replacing the oaks as they die.

A full century may pass before this happens but the offspring of the existing oaks will probably establish themselves in some other, unwooded, area.

CONCLUSION

The oak seedlings which are presently growing beneath other oaks are unlikely to survive and grow into the canopy of the future. In Garscadden Woo d the most likely explanation

for the poor survival of these trees surely is that the biotic pressures on these shaded individuals are too severe.

Root competition has been suggested as being an important biotic pressure on the trees but there is no data to show how important this is here. The grazing of herbivores may inhibit seedling growth and survival but this is unlikely to be the major pressure in Garscadden Wood. It is more likely that either oak mildew or defoliating caterpillars are causing the poor survival of the young oaks in Garscadden Wood.

B. HORIZONTAL OAKS (Plate 6a)

Within the wood there are a number of oaks and other trees which have long since blown down and yet which are still alive (the oaks are marked I - VII on the map on page 134). These show just how resilient the trees are. As with the felling of a trunk in the centuries-old practice of coppicing so here an apparently disastrous event in its life is not its end.

Conditions have not always allowed a fallen tree to survive. Old trunks completely devoid of branches, gradually

disappearing beneath a carpet of vegetation, can be found here as in any wood. But some of the trees have sprouted new vertical shoots which are successfully growing upwards. Indeed in places the number of new shoots growing up gives the appearance of a linear thicket. Clearly the growth of these shoots is only possible where there is a sufficient amount of light. The falling of a single tree, thereby creating a gap in an otherwise dense canopy, would rarely result in this survival. However in Garscadden Wood the canopy is not very dense and the survival rate of these fallen trunks is quite high.

In the most studied part of the wood , the head of the "tadpole", there are seven fallen oaks which are still alive. Two trees, marked VI and VII on the map have fallen only recently, probably only a year ago judging from the state of the root plates and the uncolonised ground exposed beneath them. One tree evidently felled the other and it still lies half supported on top of it.

The other horizontal trees are all very similar in appearance with substantial shoots growing upwards. Coring of these shoots showed them to be 20-25 years old and it seems likely that they were blown down in the storm of January 15th 1968. The angle at which they now lie is shown on the map - all approximately towards the north indicating a southerly gale.

The connection between the shoot and the roots seems remarkably tenuous in some of the trees, such has been the damage to the trunk. How much longer these trees will grow and survive can only be guessed at, their survival to date seeming most unlikely. In some cases the water demand for the enlarging trunks may soon exceed its supply and the trees will then die. Nonetheless one can only marvel at the resilience of the trees and their ability to survive.

C. FLORA OF GARSCADDEN WOOD

A full species list for the wood is enclosed in the appendix.

As parts of Garscadden Wood are ancient there may be species of plant found in it that are particularly associated with ancient woodland. The growth habits of a plant tend to restrict it to particular habitats and many plants are adapted to the conditions which exist under the canopy of trees. This is more than simply the reduced light intensity, other important factors including the absence of grazing, the absence of ploughing and the absence of competition from tall herbs (Rackham 1980). Typical woodland plants found in Garscadden Wood are bluebells (*Hyacinthoides non-scripta*), wood sorrel (*Oxalis acetosella*) and wood anemone (*Anemone nemorosa*).

Yet some plants seem to be particularly associated with ancient woodland and as such can be regarded as indicator species. These will tend to be species with a very poor colonizing ability so they rarely establish themselves in recent or secondary woods and their incidence in such woods is very low (Peterken 1974). Only if a wood has been in existence for a long time can populations build up. These woods would normally be ancient and would very often be primary. In his study of the ancient woods of central Lincolnshire Peterken identified 49 species which are normally confined to primary woodland. The plants are categorised according to their degree of restriction to primary woodland sites.

Of the 149 species found in Garscadden Wood only eight are species which were found by Peterken to be restricted to primary woodland. Equisetum sylvaticum and Oxalis acetosella, as found in the upper area of maidens in Garscadden Wood, are listed by Peterken in his Group 1 - plants wholly confined to primary woodland. Luzula pilosa (found in the ancient part of the wood) is listed as being in Group 2 - nearly always confined to primary woodland with all other localities being attributable to survival on the site or to planting. Anemone nemorosa, found in the ancient part of Garscadden Wood, is categorised as a Group 3 plant - almost confined to primary woodland although it may "very rarely" colonize secondary woods.

Four other plants appear both in the lists of Peterken and in the Garscadden data. These are

Lysimachia nemorum - Peterken's Group 3 : almost confined to primary woodland, very rarely colonizing secondary woodlands:

Adoxa moschatellina, Veronica montana - Peterken's Group 4: - most localities in primary woodland but with clear evidence that colonizing can occur:

Conopodium majus - Peterken's Group 5: occurs in other long-established habitats in addition to presence in primary woodland

I have not seen any of these plants myself and so am unable to state in which part of Garscadden Wood they are to be found.

This lack of corroboration between Peterken's list of plants and those of Garscadden Wood should not be used to question the ancient status of Garscadden Wood. Rather the value of identifying such indicator species is somewhat restricted. While certainly useful for comparing woods in the same locality problems arise if woods from different parts of the country are considered. Clearly the climate and environmental conditions in west-central Scotland do not mirror those in Lincolnshire and accordingly different plants will be particularly associated with ancient woodlands here.

The full danger in attempting to extrapolate such data for use in different parts of the country becomes evident when one

considers, not so much the **lack** of "indicator" species in what are known to be ancient woodlands, but the presence of such indicator species in woodland that clearly is secondary in nature. For example Mercurialis perennis is regarded as having an affinity for ancient woodland (Rackham 1980) and yet in the Glasgow area it is a plant found in a number of localities. Dickson (1991) states that it is found along the disused railway between Blantyre and East Kilbride and observations of this kind are common. Equally Rackham (1980) states that in Eastern England Epipactis helleborine has a strong affinity for ancient woodland and yet it is a common plant of Glasgow gardens and other urban areas. Dickson (1990) describes its occurrence in private gardens, parks, cemeteries, woodland, scrub, roadsides and meadows.

The plants of Garscadden Wood are thus not particularly unusual. With the amount of disturbance in the wood it is scarcely surprising that a large number of ruderals are to be found. It is also significant that so many typical woodland plants are found, even in the parts of the wood that have virtually no tree cover. This stems from their origin as areas of ground which were once wooded.

D. DRUMCHAPEL AND ITS EFFECT ON GARSCADDEN WOOD

The Garscadden Estate, of which Garscadden Wood was once a part, was compulsorily purchased by the Corporation of Glasgow Housing Department in the 1940s. Since then the housing scheme has gradually expanded and it now occupies most of the former estate and stretches up to the edge of the wood. What has been the effect of this on the ecology of the wood?

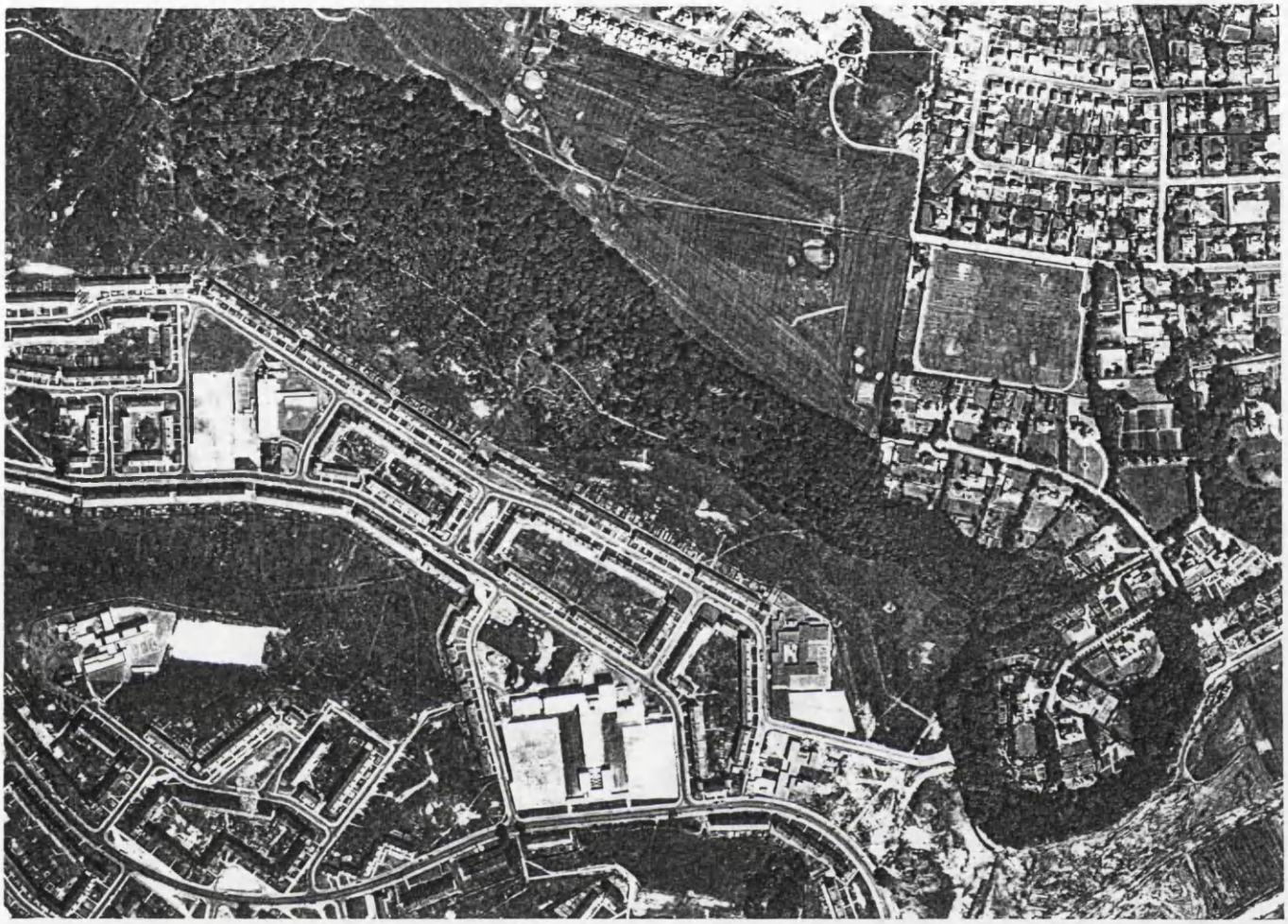
A topographical change which has probably occurred as a result of the construction of roads and houses can be seen at the southern edge of the wood. As shown on the map there are two areas at the southern boundary where there appears to have been soil cast up into the wood. This "made" ground is flat-topped and appears to be of a different soil type. It bears a different flora from any other part of the wood and the species found here are typical ruderal species such as Ranunculus acris and Taraxacum sp. The woodbank disappears in these areas and it was presumably destroyed when the soil was deposited here.

The other effects are ongoing and less quantifiable. One might assume that the open areas in the wood are the result of vandalism and burning since these are quite clearly practices which occur now. Yet aerial photographs show that these open areas were already present before the houses extended up to

Garscadden Wood photographed from the air

Date: 23.08.47

Scale: 1:10 000



Garscadden Wood photographed from the air

Date: 17.07.65

Scale: 1:7500

meet the wood. The 1947 photograph very clearly shows the large cleared area in the western part of the wood. Equally the large open area in the tail of the "tadpole" is also present at this date. It is true that the area to the south of the main track is now more open than it was then and this may well be related to the housing but it would be totally wrong to suggest that it has been the proximity of the housing which initially led to the creation of these open areas.

The 1965 photograph shows regeneration occurring in these two open areas, most dramatically in the western area. The housing now reaches its present extent and the southern fringe of the wood has certainly been altered as suggested above.

It could perhaps be argued that the proximity of the housing has prevented colonisation of these **already existent** open areas by trees. The 1965 photograph, showing a canopy beginning to form in the open area, confirms this. The succession shown in this photograph has not continued. The full implications of this and how tree regeneration in the open areas of the wood can be encouraged are discussed in the next section.

-14-
CONSERVATION AND FUTURE MANAGEMENT

Garscadden Wood is undoubtedly of interest and deserves time and effort to protect it. Of Ratcliffe's 10 criteria for evaluating a site (Ratcliffe 1977) three are particularly applicable to Garscadden Wood : rarity, typicalness, and recorded history.

Garscadden Wood is not home to a rare assemblage of species although together with other members of the Glasgow Natural History Society I have observed Purple Hairstreak butterflies (Quercusia quercus) here. However this is not the only significance of "rarity". In this case it is the rarity of the ecosystem as a whole which is important. Clear examples of ancient managed woodland are relatively common in England (see Rackham's books) but not in Scotland. Garscadden Wood is one of the clearest examples in Scotland and it is typical of the genre with the multi-trunked oaks, the remains of woodbanks and the changes in size and shape of the wood over time.

These features and documentary evidence have allowed the chronology on page 148 to be compiled. Overall the wood's importance can be said to stem from the fact that it stands as a living monument to the methods of silviculture practised in the past, albeit an altered one. The individual trees which have survived so long are probably direct remnants of the original forest cover and as such are of great importance.

One must assess whether the wood is currently under threat and what potential threats there may be in the future. As discussed in the last chapter the aerial photographs show the extent of recent change in the wood. Overall the amount of change has been relatively small, the disturbance from the nearby housing causing no major changes and indeed preventing succession (ie natural change) from occurring. Burning and vandalism do, in some ways, mirror the traditional management although the disturbance may be more frequent than from the traditional coppicing.

Garscadden Wood is currently in the ownership of Glasgow District Council but is it is under the management of The Kilpatricks Project. This is a group, funded largely by the local authorities, with the aim of encouraging the population of the area to exploit and enjoy their rural surroundings. A management plan for the wood was commissioned and prepared by the Central Scotland Countryside Trust and this is used here as

a framework to consider the management issues concerning Garscadden Wood.

The stated aims of this management plan are:

1) to ensure the long term survival of the wood
2) to maximise its value as a wildlife habitat
3) to preserve its value as a landscape feature
4) to encourage public access and use
5) to encourage use for environmental education
6) to consider the development of woodland products where applicable.

In order to achieve each of these aims detailed proposals are made and these are now considered in turn.

1. LONG TERM SURVIVAL

No specific recommendations are made to ensure that the first of these aims is met, it was perhaps being outwith the remit of this organisation. This will be discussed later.

2. WILDLIFE CONSERVATION

The stated aim here is to "re-establish" climax woodland of oak and ash with associated species. Exotic species will be removed and desirable species encouraged to replace them.

This process has already begun in the eastern part of the wood with the removal of sycamore (and plans to remove the coniferous species in the future). It is worth considering the value and the likely success of this removal ie. should sycamore and Scots Pine be removed and is their elimination from the wood a realistic aim? It is true that the former species is not native to Scotland and in a "natural" type of woodland would not be present. Sycamore has however been present in Britain since the Middle Ages (Rackham 1980,see also Morton Boyd 1992). It has certainly become naturalized and it is an invasive species of deciduous woodland. Its presence in Garscadden Wood may thus be entirely natural.

The Scots Pine are more likely to have been introduced to the wood by man. Although a dominant species in some parts of Scotland it is unlikely that they were ever present in West Central Scotland in large numbers (Bennett 1984, Birks 1989, Dickson 1993b).

It is thus accepted that these species are not native here; the issue is whether every non-native species should be removed. The exotic larch trees growing in the eastern part of the wood are surely a different case from the sycamore and possibly the Scots Pine; they are patently there as a result of planting and they appear very much out of place. In a natural wood they would not be present.

The situation with the sycamore and pine is less clear-cut. Aesthetically they are less foreign, and it can also be argued that they are of greater value to wildlife. For example it is thought that the sugary secretion of sycamore leaves attract aphids which in turn attract birds (Elton 1966). Moreover neither species is as aggressively invasive as some exotic species eg. Rhododendron, which tend to prevent tree regeneration. With the sycamore and the pine it is more of a subjective feeling that, seeing them as foreign, wants their elimination from the wood.

A further consideration is whether or not elimination from the wood is practicable. When a sycamore tree is cut it coppices very effectively. This is a well known phenomenon and the Garscadden Wood management plan states that all sycamore stumps should be treated with a systemic herbicide to prevent this. This treatment has either not been carried out, or has been done so ineffectively - Plate 6b shows just how rapid the regrowth is from cut sycamores in Garscadden Wood.

In my opinion the removal of sycamore should not be attempted as the effort required is not justified. It would only be necessary if, in the future, sycamore became too dominant and began to prevent the regeneration of other species. On the other hand, pine and larch are more "foreign" and more easily removed. Ironically they are, at present,

being left as they are a potential source of revenue in the future. There is obviously a conflict of interests here.

Other proposed measures to promote wildlife conservation in Garscadden Wood should also be considered. It is stated that the area of bracken should be reduced and this is an opinion I would endorse. One consequence of the repeated fires in the wood has been to increase the amount of bracken. This is a common occurrence, the large rhizomes surviving unharmed while small trees are killed. Bracken does now dominate large areas in the wood and the dense shade which it then casts inhibits recolonisation of the clearings by trees. This is probably the mechanism whereby the afore-mentioned lack of succession in the clearings has come about.

Unfortunately bracken control is extremely difficult to achieve. As stated, fire only increases its dominance while cutting is largely ineffective unless sustained over many years. Some success may be achieved by planting tree saplings in small areas which have just been cleared of bracken by digging but this is very labour-intensive. Alternatively one must resort to chemical spraying and this is undesirable because of its effects on other plants. Nonetheless such is the extent of bracken dominance in some of the clearings it may well be the only genuine option.

As well as the removal of unwanted species it is proposed that active efforts are made to encourage the growth of desirable species. It is suggested that planting of native species should occur where natural regeneration is inadequate. This must be carefully considered:

1. Is this planting necessary?
2. If so, how effective is it likely to be?

It is primarily in the large clearings that planting is envisaged and it is true that with the present bracken cover such active measures would accelerate the re-establishment of tree cover here. The suggested species for planting are Quercus spp, Betula spp, Sorbus aucuparia, Prunus spp, Ilex and Fraxinus excelsior. All of these are already present in the wood and so this does seem a suitable mixture.

The main problem will, of course, be whether or not such planting will be effective. Grazing of planted trees is unlikely to be significant but fires almost certainly will be. The fires which have been so common in the past would undoubtedly kill young trees. Moreover, unless the planting of the trees was small-scale and discreet, they would probably only be the actual focus for future vandalism.

It is questionable whether the proposed expenditure for this tree planting (estimated at more than £3600 in 1992) is

justifiable. Just as with the removal of exotics there is the irony here that these proposals are aimed at artificially producing a "natural" wood. Perhaps there is no alternative, such has been the level of past interference by man.

Edge planting of shrubs and small trees is also proposed (eg. hawthorn, blackthorn, hazel). I would argue that the value of this is even more questionable since these are typically pioneering species, ideally suited to natural colonisation, and there is no shortage of them in the wood.

In summary it is proposed that for the purposes of nature conservation a "natural" wood should artificially be recreated. This will involve the selective killing of non-native species and the planting of native ones. The value of these steps is questionable, the effort and expense of removing sycamore not being justified by the increase in "naturalness". The most obvious species for removal are the only ones which are at present being left ie. the larch. If these were removed than there would perhaps then be a case for planting broadleaved species here as there would be no tree cover in the eastern part of the wood at all. Natural recolonisation would in time occur but it might be considered desirable to speed up this process.

In the bracken dominated clearings planting may also be of some value although the main priority must be to prevent the further domination of, and spread by, bracken.

3. LANDSCAPE AND AMENITY

Recommendations for maintaining Garscadden Wood's landscape and amenity value primarily involve the removal of litter and signs of vandalism. These actions are obviously highly desirable.

There is only one specific recommendation that may conflict with the scientific value of the wood. It is stated that any dead or dying tree which is considered a potential danger to the public should be removed. These trees constitute an important habitat for invertebrates and fungi and so their removal is undesirable. This said it need not be a source of conflict, provided that it is only those trees which are genuinely constituting a danger which are felled and that they are allowed to rot on site. The temptation to sanitise the wood must be resisted as this will seriously reduce its value for wildlife.

4. RECREATION

Maintaining or developing the recreational potential of the wood will almost certainly conflict with its value for wildlife; ideally there would be no human intrusion at all. This is obviously not an option, especially as the stated aim of the Kilpatricks Project is to encourage the use of the countryside by the urban population.

The two aims are however not incompatible. It should be possible to allow a certain amount of use of the wood without severely damaging it. It is thus most unfortunate that it has been felt necessary to provide new paths through and into the wood. These are rapidly destroying the very real feeling of "wildness" and "naturalness" which the wood has. It is appreciated that good access to the wood is necessary but I would urge that the construction of new paths is minimised. The aesthetic appeal of such woods largely depends on the lack of human tidiness and control - as Peterken (1981) says wilderness is an "essential safeguard against over civilisation" and that it is a "counterpoint to the artificial contrivances of modern living and a release from the claustrophobia of urban crowds".

More serious would be if these paths, or the increased use of the wood, harmed the ancient trees. Provided the construction of new paths is minimised then this should not be a problem.

5. EDUCATION

Garscadden Wood is rightly seen as an excellent resource for environmental education. It is even suggested that traditional management practices such as coppicing and pollarding could be started up in the wood to demonstrate old methods of woodsmanship. The full implications of these latter ideas are discussed later but it is unarguable that such a resource as this should not be utilised for education.

6. TIMBER PRODUCTION

Small-scale production of timber may be possible through the removal of the exotic trees. This is envisaged for some stage in the future when these trees have reached maturity although, as argued, there is a strong case for removing them now. If coppicing or pollarding were reintroduced then this would be another source of potentially saleable wood. None of these methods of harvesting timber would necessarily have an adverse effect on the wildlife of the wood or its scientific value, as will be discussed below.

RECOMMENDATIONS FOR THE FUTURE MANAGEMENT OF GARSCADDEN WOOD BASED UPON THE RESEARCH CARRIED OUT FOR THIS THESIS

In the above consideration of the management plan there have been some suggestions based upon new information gained in this research project. These deserve fuller analysis:
ie. what new information has this research provided and what are the implications for the future management of Garscadden Wood?

The main finding of this research has been to show just how important, both historically and scientifically, Garscadden Wood is. The case for its conservation and protection is thus greatly strengthened. Specific features of interest ie. old trees and earthworks, have been identified, and the likely history of the wood has been charted.

Considering the individual trees and earthworks, the issue of how these should best be protected arises. The most direct method - fencing or marking them - would probably prove counter productive, serving only to draw the attention of vandals to them. Indeed they have shown themselves to be remarkably resilient in the past and it is probably the case that their future is most sure if they are allowed to remain unmarked. Certainly more people must be made aware of their existence

(the trained eye can soon identify them) but physical marking of features is probably inadvisable.

The disadvantage of this strategy is that some large-scale change could take place in the wood without anyone being aware of what is being lost. History contains numerous examples of ancient woods which have been "developed", or grubbed out and replanted, leaving no trace of their ancient past eg. Crookston Wood. At present there seems little danger of this although the present path construction could scythe through an ancient woodbank or damage one of the inconspicuous but ancient oak rings. Education about these trees is thus of prime importance.

The knowledge gained about just how important Garscadden Wood is should affect future considerations regarding its recreational value. This is not just a wood to be developed as suits the immediate demands of the public; it is of national importance and hence paths and general access should not be encouraged to the detriment of any of its historical features.

Conversely its educational value is, if anything, enhanced by the knowledge gained. In addition to the features of any wood which makes them excellent teaching resources about the environment Garscadden Wood has much to show about man in past centuries and how he, sustainably, managed his resources.

Utilising the area as a teaching resource seems to be a sensible way forward, especially as this can be combined with educating more people about the importance of the ancient trees and earthworks.

There are suggestions that the whole wood could be designated a local nature reserve. This would achieve several things:

a) The scientific and historical importance would become better known, thus protecting against future developments or destruction. Greater involvement from local people would then result; if they can be made to feel that it is their area then this is likely to be the best form of long-term protection.

b) Greater use would be made of the area by local people for educational purposes eg. greater involvement from local schools, and this will enhance a) above.

c) Recreational use could then be seen in its proper context ie. if there is a conflict of interests it should then be clearer that conservation of the wood and its features has to be the main priority.

This then should perhaps be a priority for the Kilpatricks Project. The infrastructure already exists ie. the manpower, organization and some financial arrangements. Garscadden Wood could then be marked out as a reserve with information boards showing the unique features of the site. Those that were

interested could then seek out the relevant areas. As already indicated care would have to be taken not to mark out the individual trees or earthworks.

What are the implications for future timber production? It is suggested in the management plan that coppicing or pollarding could be re-introduced. Clearly there is little historical basis for introducing pollarding as this has never been extensively practised in the wood. But coppicing was a well developed system and in many such woods it has been considered entirely appropriate to resume the traditional methods of management. This has been done on an educational basis, for harnessing of timber products, to recreate the sort of woodland which was common in the past and the wildlife which was associated with it.

Based on a study of Brigsteer Wood, Cumbria, and on a general review of the literature Barkham (1992) shows that there can be several benefits from reintroducing coppicing. Referring to ground flora he states that, in comparison with a policy of non-intervention, coppicing results in a valuable and attractive mixture of herbaceous species. This is brought about:

1. by the increased trampling and disturbance of each coppice cycle which reduces the competitive dominance of some species eg. Mercurialis perennis

2. by the resultant reduced level of interspecific competition and by the periodic appearance of bare ground; these may be necessary for the reproduction of some species.
3. by the increased growth of certain light-demanding species immediately after the coppicing; these are then gradually replaced by shade tolerant species.

Similarly Rackham's now classic study of Hayley Wood describes the spectacular increase in the flowering of certain species such as violet, bluebells, anemones and primrose following coppicing (Rackham 1975).

The effects are obviously not confined to the ground flora. Reviewing the literature Barkham (1992) also shows that the act of coppicing can be favourable for a variety of mammals, birds and invertebrates.

Set against this Goldsmith (1992) suggests that coppicing may be something of a "conservation panacea" and that in some cases it can produce a "dwarf, uniform, even-aged, biologically impoverished, nutrition-depleted woodland". Care must therefore be exercised in the choice of species to be coppiced, the length of the rotation, deciding whether or not to remove cut wood, and whether or not to exclude deer and other animals from recently cut areas. As Goldsmith points out there is still controversy over what is the best procedure in many of these cases, largely depending upon which plant or animal

community one is aiming to favour. For example Fuller (1992) shows that the effects of coppicing are different for each bird community and that its main value is in the creation of a spectrum of woodland habitats. Goldsmith (1992) further states that coppicing should ideally be combined with "standards" to give greater diversity.

Considering the practical and commercial implications of coppicing Evans (1992) states that the market for coppice products is currently firmer than at any time since World War II. Despite this Booker and Tittensor (1992) argue that for most woods coppicing will not be a commercially viable operation and will depend upon the action of volunteers, so time and energy consuming is it.

Reintroducing coppicing may thus be valuable in some situations but it is not necessarily worthwhile. This will be the case for Garscadden Wood - its present nature being such that it would probably be of limited value at the moment. Coppicing is most beneficial in a dense closed wood where the felling creates greater light conditions and general disturbance. The cutting of areas or hags creates a mosaic of habitats; this promotes a diversity of plant and animal life.

Such a mosaic already exists in Garscadden Wood as a result of the several clearings and the stages of regrowth in

each one. It can be argued that at the moment what is important is the re-establishment of genuine tree cover in the southern part of the wood and in the clearings. These areas are floristically poor and in addition their landscape and amenity value would greatly be increased by re-establishing tree cover.

If one were to reintroduce coppicing now it could only be by felling some of the mature trees and in a relatively treeless wood such as Garscadden Wood this seems rather unwise. This is not to say that it would not be a beneficial practice at some stage in the future. If a true canopy can be successfully re-established then coppicing, particularly in the areas away from the houses where vandalism has been least, could be a valuable way of maintaining the diversity and interest of the site.

CONCLUSION

At present the survival of Garscadden Wood does not seem in question. There is a certain degree of human damage and interference but the resilience of the vegetation is such that it has remained relatively unchanged. Indeed this interference is largely preventing natural change from occurring in the wood.

The long term survival of the wood is only likely to be threatened by large-scale development, although there are no indications of any at the moment. This can probably best be prevented by raising the level of public awareness, as would be achieved by designating the area a Local Nature Reserve. Garscadden Wood is virtually unique in this area - it is certainly one of the best surviving areas of an ancient managed woodland in West Central Scotland. It must be protected.

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APPENDIX

ABBREVIATED SPECIES LIST FOR GARSCADDEN WOOD PREPARED BY JIM DICKSON AND KEITH WATSON AS PART OF THE FLORA OF GLASGOW PROJECT

Nomenclature follows Stace (1993).

Acer pseudoplatanus
Achillea millefolium
Achillea ptarmica
Adoxa moschatellina
Aegopodium podagraria
Aesculus hippocastanum
Agrostis capillaris
Alchemilla glabra
Alnus glutinosa
Alopecuris pratensis
Angelica sylvestris
Anthoxanthum odoratum
Anthriscus sylvestris
Arrhenatherum elatius
Aster novae-angliae
Athyrium filix-femina
Betula pendula
Betula pubescens
Brachypodium sylvaticum
Calystegia silvatica
Capsella bursa-pastoris
Cardamine hirsuta
Centaurea nigra
Cerastium fontanum
Chamerion angustifolium
Chenopodium album
Chrysosplenium oppositifolium
Circaea lutetiana
Cirsium arvense
Cirsium palustre
Conopodium majus
Corylus avellana
Crataegus monogyna
Cynosurus cristata
Cytisus scoparius
Dactylis glomerata
Deschampsia glomerata
Deschampsia cespitosa
Digitalis purpurea
Dryopteris affinis
Dryopteris dilatata
Dryopteris filix-mas
Elytrigia repens
Epilobium hirsutum
Epilobium montanum
Equisetum arvense
Equisetum sylvaticum
Euphrasia officinalis
Fagus sylvatica
Fallopia japonica
Festuca gigantea
Filipendula ulmaria
Fragaria vesca
Fraxinus excelsior
Galeopsis tetrahit
Galium aparine
Geranium pratense
Geum urbanum
Glyceria notata
Hedera helix
Heracleum sphondylium
Holcus lanatus
Holcus mollis
Hyacinthoides non-scripta
Hypericum perforatum
Hypericum tetrapterum
Hypochaeris radicata
Ilex aquifolium
Iris pseudacorus
Juncus articulatus
Juncus bufonius
Juncus conglomeratus
Juncus effusus
Lapsana communis
Lathyrus pratensis
Linaria vulgaris
Lolium perenne
Lonicera periclymenum
Lotus pedunculatus
Lotus uliginosus
Lupinus polyphyllus
Lycopus europaeus
Lysimachia nemorum
Lysimachia punctata
Matricaria matricarioides
Mentha spicata
Mercurialis perennis
Odontites vernus
Oxalis acetosella
Persicaria amphibium
Phleum pratense
Plantago lanceolata

Plantago major
Polygonum aviculare
Potentilla anserina
Prunella vulgaris
Prunus padus
Quercus robur
Ranunculus repens
Rosa canina
Rubus idaeus
Rumex crispus
Rumex sanguineus
Salix cinerea
Sanicula europaea
Senecio jacobaea
Sisymbrium officinale
Solidago canadensis
Sorbus aucuparia
Spiraea salicifolia
Stellaria media
Symphoricarpos albus
Taraxacum Taraxacum
Torilis japonica
Trifolium pratense
Tripleurospermum maritimum
Ulmus glabra
Veronica beccabunga
Veronica montana
Vicia cracca
Viola arvensis

Poa annua
Polygonum persicaria
Potentilla erecta
Prunus avium
Pteridium aquilinum
Ranunculus acris
Rhinanthus minor
Rubus fruticosus
Rumex acetosella
Rumex obtusifolius
Salix caprea
Sambucus nigra
Senecio fluviatilis
Silene dioica
Solanum dulcamara
Sorbus aria
Sparganium emersum
Stachys sylvatica
Stellaria uliginosa
Tanacetum vulgare
Tilia cordata
Trifolium campestre
Trifolium repens
Tussilago farfara
Urtica dioica
Veronica chamaedrys
Viburnum opulus
Vicia sepium
Viola riviniana