THE USE OF WOODLAND IN ARGYLLSHIRE AND PERTHSHIRE
BETWEEN 1650 AND 1850

by

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CHAPTER SEVEN

THE FORM OF COPPICE MANAGEMENT

7.1 Introduction

The commercial use of Highland pinewood was considerably restricted both by the nature of the species and the form of demand for the produce (above, 5.5, 5.6). The use of semi-natural deciduous woodland was much more flexible. Firstly, the utilisation of the individual characteristics of the component species permitted sale in a wider range of markets. Secondly, all the common Highland deciduous species were capable of the production of coppice shoots. Coppice regeneration did not directly extend the area of woodland but it permitted the survival of existing woodland during periods in which conditions were unfavourable for regeneration by seed production. Coppice shoots tend to be produced by the stumps of felled trees of these species whether or not this is desired; the persistence of shoot production by stumps of unwanted species occasionally proved an embarrassment to foresters (Monteath (1824) 177).

Utilisation of this tendency allows production of a series of crops from an individual tree by repeated cutting at selected intervals; alteration of the cutting age and
the relative importance of the component species permits adjustment to be carried out relatively rapidly if the market makes this necessary. During the period in question a limited quantity of mature timber was cut but forms of coppice management were the principal commercial means of utilising Highland deciduous woodland; the nature of the system applied had significant effects on the development of woodland. Coppice management was in Scotland most commonly applied to semi-natural oakwood, and the development of formal coppice management was most significant in the Highlands and their margins. As shall be seen later Perthshire and Argyllshire were in areal terms the most important coppice districts, although coppice was also managed in the upland parts of Dunbartonshire and Stirlingshire, and to a limited extent in other Highland counties.

7.2 The history and ecology of oak in the Highlands

Oak has been subsidiary to other species in the Highlands as a whole throughout the post-glacial period. Birch and alder appear to have been the most common dominant species in the native woodland of the Highlands since the end of the Boreal period, oak being a subsidiary in mixed woodland and occasionally the dominant tree (Durno (1956) 181-5, Durno (1957) 180); examination of sites in the southwest Highlands, however, has shown that oak was important there after the end of the Boreal period,
declining in relative terms at the beginning of the present climatic period (Donner (1957) 256-7). It has already been noted that McVean and Ratcliffe's reconstruction of the vegetation of Perthshire and Argyllshire at that time indicates widespread oak dominance in both counties (above, 2.4).

The reconstructed pattern as a whole indicates that the south and west Highlands, including not only Argyllshire and Perthshire but the northern parts of Dunbartonshire and Stirlingshire, contained the most significant areas of oak dominance north of the Highland Boundary fault; in the north and east Highlands oak dominance was localised and intermittent. Oak dominance was universal on low ground south of the Boundary fault (McVean & Ratcliffe (1962) Map B). During the present climatic period environmental and more particularly anthropogenic factors have greatly reduced the extent of all forms of deciduous woodland in the south and west Highlands, but most of the few surviving semi-natural oakwoods of the Highlands lie within this area (McVean (1964a) 155-6).

It has already been noted that birch has largely replaced oak as the dominant tree of low-lying deciduous woodland in Perthshire and Argyllshire, and this has evidently occurred throughout the south and west Highlands (above, 2.4). The ecological basis for the decline of oak has already been discussed (above, 4.8); the factors most important in reducing the competitive ability of oak
in Highland conditions appear to be the slow growth rate and poor seeding of the species near the northwestern margin of the European distribution (Jones (1959) 177, 193-4, McVean & Lockie (1969) 55). Oak was important enough in the south and west Highlands to provide the basis for extensive coppice management before 1850, however, and a relatively rapid decline must have taken place since then; as late as 1900 there was a distinct zone of oak woodland on the Highland edge in Perthshire (Smith (1900) 446). It is unfortunately not generally possible to establish the relative importance of oak among the deciduous species of the area during the period between 1650 and 1850.

Early observers described the existence of woods of oak and other timber of commercial value less frequently than pine (Mitchell, ed. (1906-8) V.2, 159-60). It is very unlikely that deciduous woodland was less common than pinewood, but the native deciduous species are individually less distinctive in appearance than pine and it is possible that deciduous woodland as a whole was common enough to be thought unworthy of comment. The lower commercial value of Highland deciduous timber in the earlier part of the period also contributed perhaps to the paucity of descriptions. Evidence about the later part of the period is little better; even the more detailed local surveys and descriptions generally indicate no more than the number of component species and their approximate relative importance (McArthur, ed. (1936) 66, 82).
It may finally be noted that there is some debate about the status of the two principal recognised British oak species, *Quercus robur* and *Q. petraea*, in the Highlands; it appears that *Q. petraea* is the native oak of upland environments in north and west Britain, a belief which is supported by the distribution of the species (Jones (1959) 175, Yapp (1961) 4-5). *Quercus robur* will grow in such conditions, however, and the belief that it is the superior species has led to widespread planting throughout Britain (Jones (1959) 175). Cousens has suggested, however, that although in the absence of man the two oaks are distinct species occupying different habitats, the juxtaposition of the two as a result of planting leads to a certain amount of hybridisation, which is identifiable among Scottish oaks (Cousens (1962) 170-1).

Oak has very commonly been planted in the south and west Highlands and it is therefore possible that hybridisation has taken place. It is especially important to note that vacancies in semi-natural oak coppice were sometimes filled by planting, and that in other cases oak was deliberately planted for use as coppice; in both cases *Quercus robur* may have been employed (below, 7.6). The present pattern of relict oak wood and scrub is therefore partly self-seeded and partly planted but in many cases distinction on superficial grounds is not possible; the likelihood that *Q. petraea* stock of local provenance was used in planting prevents accurate distinction on the basis of
species. It is therefore not possible entirely to isolate genuine semi-natural coppice at present, and many coppiced woods are likely to possess in varying degree the different characteristics of the two component species and their hybrids.

7.3 Coppice management

Coppice management is a system of forestry which utilises the tendency of trees of many deciduous species, including oak, birch, alder, hazel and other species common in the Highlands, to produce supplementary shoots (Köstler (1956) 362, 365). These trees possess epicormic buds on the trunk and lower branches which remain dormant unless regularly exposed to full sunlight; in some circumstances sufficient light may be available while the main crown and stem survive but coppice working is invariably based on use of the strong growth of shoots from the buds on the outer faces of the stump or 'stool' left after the cutting of the main bole (Edlin (1956) 3-4). Selection of the best of the shoots may allow production of a crop of mature timber from such stools but in coppice management stools are usually cut over at intervals of twelve to twenty-five years (Hiley (1954) 170-1, Köstler (1956) 365); the shoots of each stool are generally cut simultaneously and the cleared stool is left to produce another crop. A stool will usually provide a sequence of crops, especially if it is initially cut over at an
early age; old stools tend to produce weak shoots and it is possible that continued production of coppice on a site exploits soil fertility more than other forms of forestry, but under careful management woods have been maintained as coppice for periods of several hundred years (Edlin (1956) 3-4, Köstler (1956) 357).

Coppice management does not require woodland of high quality and there is some support for Hiley's suggestion that coppicing originated in intelligent utilisation of scrub forest after indiscriminate felling (Hiley (1954) 168). Turner has recently suggested that changes in the composition of a series of pollen samples from a peat site in Shropshire indicate the coppicing of hazel as early as the third century B.C. after the felling of the mature trees of a wood (Turner (1965) 351). The repeated production of shoots has encouraged the treatment of coppice as a crop under widely different systems of management; at the most primitive level crops of coppice shoots have been harvested without attention to conservation or improvement of the stock but systems of management have been developed which provide satisfactory relationships between the size, quality, and frequency of the crop and the continued productivity of woodland.

The most important requirement of any form of coppice management is protection from grazing or browsing animals, and this in almost all cases is achieved primarily by
enclosure. Coppice is more vulnerable to grazing damage than other systems employed in British forestry; in the few years after cutting the crop consists of a large number of edible small stems near the ground and even a few hours of grazing can damage the value of a crop considerably (Robertson (1794) 98, Monteath (1824) 144, Gilchrist (1874) 126). Other types of woodland are in comparable danger during the seed and seedling stages, but although grazing may inhibit farther regeneration the trees are mainly secure from danger through most of their growing lives; coppice is cut over at frequent intervals and is therefore periodically restored to a vulnerable juvenile state.

Monteath suggested that young wood should be enclosed for ten years (Monteath (1824) 145); this may be equivalent to ten per cent or less of the life of a timber tree, but fifty per cent of the life of wood coppiced on a rotation of twenty years.

At its simplest a system of coppice management is a means of utilising the production of shoots and protecting the stools from which they are obtained; without some form of enclosure or conservation the use of coppice shoots is a form of exploitation rather than silvicultural management. Management systems generally incorporate other operating principles which improve the quality of coppice and the yield available, although not essential to the survival of woodland. The area of wood on an estate may be divided into a number of annual sections in order to
distribute the income from coppice over a number of years; coppice may be divided to form a 'rotation' of sections equivalent in number to the years of the cutting period, ensuring that one section of coppice is in each year at a suitable age for cutting to serve a chosen set of markets. Large timber can be obtained by the reservation of a limited number of 'standards', shoots or seedlings permitted to grow for a longer period than the surrounding coppice.

Considerably more is known about the form and development of English coppice than that of Scotland, but it is evident that there were differences between the coppice regimes of the two countries. As already noted there is evidence of pre-historic coppicing in England, and the terminology of the Domesday survey suggests the existence of formal coppice in England in the eleventh century (Darby (1950-1) 37). There is relatively little concrete evidence about the form and extent of coppicing until the fifteenth century; Edlin has suggested that formal coppice management developed extensively only when supplies of common semi-natural woodland approached exhaustion, a phenomenon first evident in southeast England and the south midlands (Edlin (1956) 100).

A certain amount of coppice produce was available to the local community but the value of coppice was in most cases primarily commercial; ironmasters, charcoal users, and others bought coppice timber on a large scale in some districts, and in others landowners deliberately founded
small industrial plants to create a profitable use for the timber. Coppice as managed in England after the fifteenth century is therefore appropriately described as a cash crop of young wood enclosed against grazing animals and common use (Hammersley (1957) 142n, 154-6). Coppice was often profitable enough to justify planting; the purity of species, small size, and regularity of many English coppiced woods suggest that they were planted for the purpose (Edlin (1956) 100-1).

When coppice management finally declined in England in the late nineteenth and early twentieth centuries hazel coppice was widespread, but sweet chestnut was common in the southeast and oak in the western part of the country. Production and profitability were sensitive to change in individual markets; a fall in the demand for sheep hurdles led to a decline in the value of hazel coppice and reduced prices for bark and charcoal led to the abandonment of oak tanbark coppice in England. Only chestnut coppice timber, regularly in demand for hop-poles and fence stakes in southeast England, remained of value after 1945 (Hiley (1954) 53, 169, Edlin (1956) 196, 198-9, Wood et al. (1967) 5-6).

The demand for timber larger than coppice could provide was commonly met by the application of a 'coppice-with-standards' system in which standards were grown from seedlings or from shoots spared when the coppice was cut
over; in some schemes of management the number of standards was arranged so that each cutting of coppice yielded a set number of mature trees of different ages (Edlin (1956) 101-2); this refinement of the coppice-with-standards system was fully established by the end of the eighteenth century (Jones (1959) 215). Production of standards was not completely compatible with coppice growth; they were widely spaced and consequently tended to be short in bole and broad-crowned. The access of light to the underlying coppice growth was therefore restricted; oak and ash cast a light shade and were generally preferred as standards (Edlin (1956) 101-2, Hammersley (1957) 149-50).

7.4 The development of coppice management in Scotland

Little information is available about the early history of coppicing in Scotland, but there is evidence of the casual coppicing of deciduous wood for local use in northern Scotland as late as the early eighteenth century. It has already been noted that on some lands areas of woodland known as 'bogs' were set aside for the use of tenants (above, 3.3). McVean found indications of coppicing of various species on islands in lochs in the far northwest Highlands; commercial cutting appears unlikely in the circumstances (McVean (1958) 202-3). Alders were frequently mentioned in contemporary records in terms which suggest that groups of these trees were informally coppiced; a late seventeenth-century manuscript relating
to the Lovat estate near Inverness contains a story describing the sending of a man in 1634 to a group of alders, described as a 'copsy buish', to cut withies (Mackay, ed. (1905) 268-9). Although formal coppice had been introduced to the Highland section of the Tay valley by the early eighteenth century, tenants were still permitted to visit young coppice and cut the outer shoots for similar purposes (EUL DC.I.37 1/3, 10).

The earliest indications of formal coppicing in Scotland relate to monastic estates. A charter granted to the abbey of Lindores in north Fife before 1250 allowed an annual supply of dry fuelwood, birch and alder timber, and hazel rods of different sizes from woods in Perthshire (Dowden, ed. (1903) 80); this suggests the utilisation of coppice regeneration in mixed woodland. In the late fifteenth and early sixteenth centuries the abbey of Coupar Angus possessed extensive woods, largely in Perthshire, and followed an enlightened policy of enclosure and preservation. The abbey had acquired Invervack in Atholl in 1289 by a charter which permitted local tenants to take wands or rods from the woods for farm implements and fences; in a tack of 1476 the tenants of Invervack were obliged '... to kep our wud, and hanyt, for thar awn gud ...' (Rogers, ed. (1879-80) V.1, 225, Easson, ed. (1947-8) V.1, 135). This was not the only instance of the 'naining' or enclosure of the monastery woods; other tenants were required to enclose woods and keep them to
profit, and in at least one case the abbey appears to have reserved land for the production of large timber (Rogers, ed. (1879-80) V.1, 170, 185).

In other cases, it is clear that a form of coppice management was employed by the abbey. In 1471 the wood of Campsie on the River Isla was divided into four equal parts and responsibility for the preservation of one of these was allocated to each of the four tenants of the farm; by 1479 the wood was partly enclosed and a tack of 1483 required the tenants to continue building walls round the wood. A tack of 1549 prohibited grazing in those woods which were hained at the time, and a nineteen-year tack of 1551 ordered that the woods, which had suffered some damage, should be divided into four by walls sufficient to protect wood from grazing animals. The tenants were to uphold the walls at their own expense 'ilk part be the space of sewin zeris eftir vther respectiu'; (Rogers, ed. (1879-80) V.1, 220, 227, 237, V.2, 65, 69). This suggests that the abbey was cutting the woods in four sections at equal intervals, each section being cut every twenty-eight years and protected for seven years after cutting.

It should be noted, however, that although Coupar Angus abbey and other Scottish religious houses maintained high standards in agriculture and land use, the number of houses in existence at any one time was small and few were in the counties north of Fife and the upper Forth
(Easson (1957) 204ff, Smout (1969) 28-9). Little woodland appears to have been coppiced outside the monastic domain; a shortage of domestic timber was evident in lowland Scotland as early as the fifteenth century and remained serious until the produce of plantations became available in large quantities at the end of the eighteenth century (Murray (1935) 4, Richardson (1921) 163-4, Smout (1960) 7). The scarcity of large timber is not incompatible with the existence of an adequate supply of fuel wood and other forms of small timber available from coppice, as scrub may remain when stands of large timber have been felled (Hammersley (1957) 151); in Scotland, however, there is no evidence that woodland was preserved or planted as commercial coppice in the lowlands on a scale comparable to that of England. Indications of the shortage of small timber are provided by occasional imports of charcoal; coals were shipped from Flanders in the fifteenth century and in 1647 Sir James Hope, possessor of the mines of Leadhills, considered the possibility of buying coals shipped to Leith from England (Paul, ed. (1919) 141-2, 168, Anderson (1967) V.1, 217).

A few small, compact, and enclosed woods were managed as coppice; some of these, primarily oakwood, existed in south Perthshire. Thus the Wood of Methven was associated in local tradition with events of the early fourteenth century; the Wood of Murthly was protected and in use as a source of timber by the end of the fifteenth
century (Rogers, ed. (1879-80) V.1, 170, Hannay, ed. (1915) 292). Both woods were still managed as coppice in the late nineteenth century (Hunter (1883) 85, 117-20). If the resources of the lowlands were limited it might be expected that the deciduous timber of the Highlands would be exploited, and the form of internal and external trade in the Highland burghs before 1600 does suggest the cutting of coppice; thus many of the forms of timber marketed in Inverness in the sixteenth century could have been obtained from coppice with standards (below, 8.2). It is also possible, however, that this material was obtained from scrub woodland containing a few mature trees and cut without regular management; the exploitation of deciduous woodland without the application of coppice management principles remained common in the north Highlands in later centuries.

Indirect evidence is available which suggests the development of coppice on the Highland fringe in the first half of the seventeenth century. The bark of young wood on the lands of Kilravock in Morayshire was sold in 1607 on terms which resemble those of later oak tanbark coppice contracts (Innes, ed. (1848) 294-5); by 1622 the laird of Leys in north Kincardineshire had enclosed young wood around Crathes on the Dee (Stuart, ed. (1852) 222). In 1650 the factor of the Cawdor estate in Morayshire was issued with instructions about the cutting of small timber as house cabbers; oak timber was not to be cut, which suggests
that suitable small oak was available but was being reserved in a form of selective coppice (Innes, ed. (1859) 292). There is more satisfactory evidence about cutting and management in the second half of the century. The Forbes estate in Aberdeenshire provides an outstanding and perhaps isolated example of enlightened wood management on the Highland fringe in the period; the attention paid to the preservation and enclosure of semi-natural seedlings and young growth indicates that part of the wood was coppice (Thomson, ed. (1919) 228, 260, 265). As shall be seen later, a number of extensive woods in south Perthshire were managed as coppice after 1650 and there is also evidence of management in north Perthshire and Argylishire (below, 8.2).

Coppice principles were understood in other parts of Scotland although they were not always put into practice. Before technical advances were made about 1690 the lead-works around Leadhills in Lanarkshire required timber both for construction and to provide fuel; it was noted in the late seventeenth century that much of the wood of Elliock in Sanquhar parish had been cut for this purpose and damaged by failure to enclose the cut stools (Anon, ed. (1823) 155). The managers of the leadworks had some difficulty in obtaining coalwood and prices were high; Smout has suggested that the sustained value of timber during the period of demand encouraged proprietors in the district to maintain their wood adequately as coppice (Paul, ed.
In the lowlands the Mastertons of Parkmill near Alloa were probably not the only proprietors of small coppices; they were cutting wood in annual sections of haggs at the age of twenty-five by 1669 and permanent enclosure of the wood was begun in 1687 (Paton, ed. (1893) 468, 470-1, 487, 489). It is evident, however, that even at the end of the century the basis of coppice working was not entirely familiar. When preparing an account of possible improvements in Scotland in 1698, Sir Robert Sibbald treated coppice as an innovation and thought it necessary to explain fully the method of cutting coppice in a rotated series of annual sections as was done in other countries (NLS MS.33.5.16).

From the beginning of the eighteenth century there is more evidence of coppice management and cutting than can easily be summarised here. The value of coppice produce rose gradually and became important in the revenue of some districts; this was emphasised when bark prices rose after the 1790s. In the 1790s the value of coppice in the parish of Ardchattan and Muckairn in Argyllshire was more than £15,000 distributed over twenty years, and the annual income of cutting in Ardnamurchan and Sunart was about £600 (OSAS V.6 (1793) 175, V.20 (1798) 294). In Perthshire the oakwoods of Clunie parish were thought to be worth £13,000 and in Little Dunkeld parish there were 800 acres (324 ha) of good oakwood worth over £10,000; in the neighbouring parish of Dunkeld and Dowally one oak coppice was
sold for £166, £551, and £1,262 sterling at three successive roups between 1750 and 1798 (OSAS V.6 (1793) 359, V.11 (1794) 187, V.20 (1798) 478-9). By 1813 bark prices were almost double their level in 1798 (below, 8.3); the sums stated in the 1790s cannot therefore be taken as indicating the peak value of coppice in these parishes.

As the century advanced the management of coppice in Scotland developed in a form divergent from that of England. Coppice in Scotland was less fragmented; much of the total area in England consisted of relatively small planted sections but in Scotland coppice was generally derived from semi-natural wood or scrub and some proprietors held exceptionally large areas. Cameron of Locheil was said to have over 4,000 acres (1,620 ha) of deciduous woodland in 1793; in the early nineteenth century the duke of Montrose had over 2,000 acres (810 ha) of oak coppice in Stirlingshire and slightly less in the adjacent part of Perthshire (OSAS V.8 (1793) 422-3, Graham (1812) 210-13). Commercial coppice in Scotland was also almost invariably associated with the production of tanbark from oak (below, 8.3); hazel and other common component species of Highland deciduous woodland were utilised when convenient but sweet chestnut, hornbeam, and other trees planted as coppice in England were of no significance in Scotland (Wood et al. (1967) 5-6).

It is therefore possible to trace a broad association between the extent and quality of coppice in Scotland and
the demand for tanbark in the country at a given time. As shall be seen later the price of tanbark in Scottish markets rose slowly until the last decade of the eighteenth century, when prices rose steeply and continued to rise until about 1813; thereafter they declined slowly towards the level obtaining before 1790 (below, 8.3). Rising prices called attention to the increased value of coppice as a form of land use. In 1805 Smith thought that wood management was the most profitable land use in Argyllshire except cultivation, although he considered that plantation of timber was more valuable than coppice (Smith (1805) 138, 147-8). A few years later it was said that the value of coppice on land of intermediate quality in Dunbartonshire was higher than that of the same land under any other use, and Walker stated that in the Highlands as a whole coppice was the most valuable form of estate forestry; in 1824 Monteath affirmed that oak coppice was the most profitable form of plantation (Whyte & McFarlan (1811) 156, Walker (1812) V.2, 249, Monteath (1824) 27-8). Although proprietors did not respond promptly to changes in the market for bark, there was a considerable expansion of the area under coppice in the later part of the eighteenth century, especially in the twenty-five years of peak demand (below, 7.6).

By the early nineteenth century so much semi-natural woodland was managed as coppice that the distinction between coppice and semi-natural woodland as a whole
became indistinct. Some observers drew attention to this; Graham noted that natural wood was generally termed coppice, and Walker considered that coppice in Scotland was equivalent to the remains of natural woods (Graham (1812) 209, Walker (1812) V.2, 191). The term 'natural wood' was very commonly used as an equivalent to 'coppice'; contemporary authors saw no inconsistency in describing the planting of natural wood (Monteath (1824) 113-14). The ambiguity of the term 'natural wood' makes it impossible to state precisely the proportion of the woodland of Perthshire and Argyllshire managed as coppice at any one time; in many cases it is not clear whether or not woodland was regularly managed or simply cut over when it became profitable to do so.

It may be suggested that the more far-sighted proprietors became aware of the value of coppice shortly after the middle of the century, and that they were only followed by the majority when increased bark prices made the profitability of coppice obvious. There was a similar lag in the abandonment of coppicing. Bark prices began to fall about 1815 and continued to decline slowly and steadily. After the middle of the nineteenth century it was clear that coppice was of declining importance; in 1861 Brown noted that coppice was less valuable than timber planting, and that there was little value in the conversion of plantation to coppice (Brown (1861) 522). In the intervening years, however, there appears to have been uncertainty
about trends in estate forestry; the planting of timber had become the dominant form throughout the Highlands, but in Perthshire some proprietors remained enthusiastic about coppice. Thus by 1845 the planting of extensive areas had reduced coppice to insignificant proportions in Blair Atholl and other parishes, and in Logierait parish pine plantation and oak coppice were being cleared to extend the cultivated area; in the parish of Comrie, however, oak coppice was still carefully managed and had increased in extent since the beginning of the century. In other parishes the conversion of plantation to coppice had continued through most of the first half of the century (ASAS (1845) V.10 (Perth), 166-7, 571, 587-9, 595, 696, 733, 1006).

There was not a uniform relationship between the value of coppice produce and the attention paid to management by proprietors; on some estates in Perthshire and Argyllshire deciduous woodland was exploited without adequate management throughout the period. It was generally recognised, however, that the standard of management improved when coppice became more profitable. Robertson considered that improvement could be traced back to 1700, and management in Argyllshire was held to have become better after the foundation of the two major ironworks in the 1750s (Robertson (1799) 231, Smith (1805) 138, below, 11.4). Graham thought that the value of coppice had risen sufficiently to improve management in Stirlingshire after 1760, but Whyte and Macfarlan believed that improved management was
a more recent development in the neighbouring county of Dunbartonshire (Graham (1812) 208, Whyte & Macfarlan (1811) 150). Most of the tanbark coppice of Scotland was in Perthshire, Argyllshire, and the Highland parts of Stirlingshire and Dunbartonshire (Gilchrist (1874) 118).

Coppicing extended to other parts of Scotland, however, especially in the period of peak demand for bark. A limited amount was managed in Angus and during periods of high prices oak, birch and other deciduous species were cut in the other Highland counties, including Sutherland and Ross-shire (Robertson (1808) 208-10, Herford, ed. (1929) 139, Anderson (1967) V.1, 467). The coppicing of wood near Leadhills has already been noted; in the late eighteenth century woods were coppiced in different parts of Lanarkshire, and in other Western counties (Anderson (1967) V.1, 467-8). Woods in the east borders were also coppiced at different periods in the eighteenth century (Craig-Brown (1886) V.1, 221, Anderson (1967) V.1, 467). Coppice was rare in the central lowlands but areas of hardwood plantation were converted to coppice in the nineteenth century (Brown (1861) 524).

7.5 The principles of coppice management in Scotland

There were no formal controls over the development of coppice management in Scotland, which unlike England had no statute specifically concerning coppice. The existence
of coppice or *sylva caedua* was recognised in Scots law primarily in relation to the ownership of the crop of timber and bark, and the Scottish parliaments did not legislate about the period of enclosure, the size and number of standards, and other matters concerning coppice (Bell (1838) 800, Nisbet (1900) 50-1, Hammersley (1957) 149-50). Scotland did not produce an early text like the brief but comprehensive treatment of coppice in Evelyn's *Sylva* and coppice was not described at any length by eighteenth-century Scottish writers on forestry, but in the period of peak profitability after 1790 a number of authors described the principles of coppice management in Scotland. Most of them might best be described as educated amateurs to whom knowledge of forestry was an aspect of rural life; the most detailed account of coppice management, however, was written by Robert Monteath, whose *Forester's Guide* first appeared about 1820 and entered a second edition in 1824. Monteath was a practical forester with a particular interest in coppice, and his published works were based on more than twenty years of experience in coppice operation, largely in Perthshire and Argyllshire (Monteath (1824) 122-3). Later accounts were provided by James Brown, whose *Forester* passed through several editions in the middle of the century, and Andrew Gilchrist, who wrote in the 1870s when Scottish coppice was in decline; in both cases the description is brief but based on practical experience. The writers were in general agreement on most points and it is of some value to determine whether
practical management in that period and earlier was equally uniform and as high in quality as that described in abstract terms.

It was not disputed that enclosure was vital to the success of coppice operation; this had been recognised in the monastic forestry of the fifteenth century and was acknowledged at the beginning of the eighteenth century, when the author of the proposals for the regality of Atholl desired that proprietors should enclose their woods with goat-proof fences (EUL Dc.I.37/1/3, 12). Later authors continued to emphasise the importance of adequate enclosure. Graham pointed out that uncontrolled grazing, by preventing healthy regeneration, would eventually remove woodland cover; the ragged scars left on shoots damaged by livestock were sources of infection (Graham (1812) 208). Monteath thought grazing completely incompatible with the rearing of young oak coppice and suggested that the woodgate should be locked as carefully as a desk containing money; even the pasturing of workhorses in coppice was inadvisable after cutting had begun (Monteath (1824) 73-4, 143-4). Gilchrist noted that oak coppice was the timber crop most vulnerable to grazing damage and that the harm done in a few hours might have effects lasting several years (Gilchrist (1874) 126).

There was less agreement over the duration of the period in which young coppice was vulnerable enough to require protection; as already noted the demand for pasture
land and the necessity of compensating tenants for the loss of grazing made permanent enclosure of coppice expensive and at times impractical (above, 4.5). The more idealistic authors wished for permanent enclosure and Brown, who was concerned primarily with the production of mature timber, thought that stock should be admitted to hardwood plantations only when the trees were about forty years old; by this criterion coppice would require permanent enclosure (Smith (1805) 139, Brown (1861) 58-9). Others were willing to accept the necessity of shorter periods of protection. Robertson thought that the period of seven years or less allowed in south Perthshire was slightly too short, and that animals were able to reach or damage many of the shoots (Robertson (1794) 98); Monteath considered ten years the minimum period compatible with the security of young coppice wood (Monteath (1824) 144).

Two factors were of particular importance in determining the age at which coppice was cut. Firstly, the markets available determined the age at which the produce could most profitably be sold (Nisbet, ed. (1908) V.2, 2-3, Brown (1861) 520-1); in Scotland the quality of bark almost invariably determined the age at which coppice was cut. As at present it was recognised that the bark of young or coppiced oak was most valuable; after a certain age there was little appreciable increase in the tannin content of the inner bark and the development of a rough and useless outer bark lowered the value of bark per unit weight.
it was frequently assumed that twenty-four years was the ideal cutting age in general terms although it was not denied that some variation was possible; careful inspection of the appearance of the bark was necessary to determine the season in which the relationship between tannin content and useless residue was apparently optimal (Whyte & Macfarlan (1811) 149-50, Monteath (1824) 119, Howes (1953) 86). The physical environment of coppice affected the growth rates of timber and bark; Brown observed that oak coppice cut at twelve or fourteen years in Herefordshire had as high a yield as coppice cut in Argyllshire at twenty-five (Brown (1861) 520-1). Cutting intervals could not be lengthened indefinitely, however; the stumps of trees cut after one hundred years or more may produce weak shoots, but a rotation of thirty years or less is generally necessary for vigorous production of coppice shoots by oak (SRO E.777/136/18, Jones (1959) 186).

There was a wide variation. The author of the Atholl proposals of 1708 considered that most coppice was cut too young and that thirty years was the minimum desirable; writing fifty years later and perhaps using English models rather than practical experience in Scotland, Justice suggested cutting at intervals of twelve to fourteen years (EUL Dc.I.37 1/3, 12, Anderson, ed. (1959) 25-6). An interval of twenty to twenty-five years was generally considered most suitable. Whyte and Macfarlan recorded
the opinion that twenty-four years was the most suitable general age for the cutting of bark, but that in cases of doubt it was safest to cut coppice younger than the accepted age; cutting at twenty-two could therefore be accepted as a suitable practical alternative (Whyte & Macfarlan (1811) 149-50). Writing about Argyllshire, Smith selected twenty years as the appropriate cutting age, and Gilchrist thought that the tannin content of oak bark grown on good soils was highest at twenty years (Smith (1805) 139, Gilchrist (1874) 120). Monteath preferred cutting at twenty-four; he noted that cutting at twenty was a recent innovation, and rather undesirable in that the quantity and quality of bark improved significantly between the twentieth and twenty-fourth year (Monteath (1824) 25-7, 121).

Cutting at a set age made feasible the division of an area of coppice into a number of sections cut regularly in sequence. The fullest development of this principle, which was understood before 1700 in Scotland, included division into a rotation of sections approximately equal in area or yield; these haggs, lots, or parcels were equivalent in number to the years of the cutting interval and it was therefore possible to cut one section in each year without interruption of the cycle (NLS MS.33.5.16). Smaller woods could be cut in incomplete rotation, in which the number of annual cuttings was smaller than the number of years in the rotation; very small areas could be cut in undivided blocks in one or two years (Nicol (1799) 299-300). Full
rotation was the most attractive in certain ways; the
proprietor was assured of a regular annual income from wood,
it was possible to estimate operating costs easily on an
annual basis, and as part of the coppice was always well-
developed the visual amenity of the wood was preserved
(Smith (1805) 139, Monteath (1824) 27-8, 114-6, Gilchrist
(1874) 119). Monteath suggested that full rotation could
be applied to woods as small as 100 acres (41 ha), with
twenty-four haggs of about four acres (1.6 ha) each (Mon¬
teath (1824) 114-15); smaller woods were more easily cut
by the other methods.

Importance was also attached to the techniques employed
in preparing the stools and the site as a whole for the
new crop after cutting over. Monteath considered cutting
and dressing to be among the most significant aspects of
management in their effects on the next crop and the long-
term health of the stool. He noted that there was some
disagreement over methods, and that some woods were treated
differently by their proprietors and the purchasers (Monteath
(1824) 122-3). In general, however, it was agreed that
stools should be cut low, smoothly, and in a form which
allowed surface water to run off (Smith (1805) 139). If
the outer edge from which the shoots developed was six or
more inches (15.2 cm) above ground level the shoots could
not easily establish their own root systems; they there¬
fore tended to be undernourished, feeble, and vulnerable
to damage by weather, grazing, and other agencies (Monteath
Stools generally have a longer useful life in coppice if the shoots are low enough at each cutting to form their own adventitious roots (Jones (1959) 187). It was thought desirable that the outer edge should be at or near ground level, allowing the production of healthy shoots which would grow vertically and soon be out of grazing range (Whyte & Macfarlan (1811) 151-2, Monteath (1824) 129, Brown (1861) 516-7, 524-6, Gilchrist (1874) 121-2). There were two approaches to the treatment of the bark remaining on the cut stool. One group held that the bark of stools projecting to any extent could safely be stripped down to ground level; this would allow shoots, which do not sprout from stripped timber, to spring near the ground and develop their own roots (Robertson (1794) 97). Others like Monteath disliked this method and considered it liable to abuse; they required that the bark should be left firmly attached to the stool and that the junction of bark and wood on the top surface should be smoothly dressed so that damage by weather could not separate them (Monteath (1824) 124-8, Brown (1861) 516-7).

Smooth cutting also limited the possibility of rot following the collection of moisture on the surface of the stool; for the same reason cutting of the stool surface in a horizontal plane was not approved. Cutting at a slant allowed water to drain off but the direction of the axe-blows makes it possible that the surface would be split; it was generally accepted that the stool was most satis-
factorily dressed by rounding it with the adze into a slightly convex shape (Monteath (1824) 127-8, Brown (1861) 516-7, Gilchrist (1874) 121-2). After one or two cuttings stools increased greatly in dimensions unless carefully managed. The bases of shoots cut over round the margins added to the diameter of the parent stool and the margins of the stool tended to rise; it was therefore likely that new shoots would be well above ground level and that the stool as a whole would have a concave form which would allow water to stand (Monteath (1824) 134-6, Brown (1861) 521, Gilchrist (1874) 131).

The second or 'Lammas' growth of oak was also of importance in the cutting of coppice; although oak shoots developed in spring there was also a period of growth from the end of June to the end of autumn and even into the winter months. After the cutting of oak coppice in summer the Lammas growth provided a crop of new shoots which might be as tall as six feet when growth stopped in winter; it was therefore important that the cutting should not prejudice development of the crop (Robertson (1799) 237, Monteath (1824) 374-5, Jones (1959) 191). Robertson noted that oak should be cut before the middle of July, as shoots springing then or later were vulnerable to frost; as shall be seen later the customary date for the termination of oak cutting was July 15, and Monteath believed that stools cut after this date could not be expected to produce shoots until spring (Robertson (1794) 96, Monteath (1824)
Lammas shoots tend to be slender and vulnerable to damage; it was therefore important that the produce should be removed before the shoots could be damaged by the movement of men and horses in the wood (Jones (1959) 191). Monteath recommended that the produce should be cleared by August 1 and that no horse and cart should enter the wood after that date; if the purchaser could not remove all the bark and timber by that date the proprietor was best advised to allocate a space for the storage of produce outside the wood (Monteath (1824) 141-3, 374-5).

Thinning, sometimes known in Scotland as 'weeding', was also regularly employed in coppice management. The growth of coppice shoots was generally vigorous, and without thinning stools tended to produce large numbers of thin and irregular shoots which were of little value except as fuel. If the crop on each stool was thinned the few straight strong shoots remaining were eventually higher in value as timber and easily stripped of bark; sale of the bark and timber of thinnings provided an additional income to offset the costs of management (Walker (1812) V.2, 248, Monteath (1824) 113-14, 159-60). There was less agreement about the number and type of thinnings than about most aspects of management; it was agreed that the aim of thinning was selection and encouragement of a few strong straight shoots on each stool, but different means were chosen to achieve this. Some believed that early
thinning was vital in preventing the development of large numbers of stunted shoots (Brown (1861) 527-8). Monteath noted that the first thinning often took place at three years, but he preferred to thin after two seasons of growth; six to eight shoots were left on each stool and a second major thinning between the tenth and twelfth years removed any which proved unsatisfactory (Monteath (1824) 152-4, 158-9). Brown preferred to thin in the second and fourth years, leaving a final crop of six shoots per stool at the second thinning (Brown (1861) 527-8).

Gilchrist favoured an initial thinning at two years and a reduction to two or three shoots per stool at eight, with a third thinning shortly before cutting to remove the less valuable stems (Gilchrist (1874) 127-8). Others preferred later thinning. According to Monteath one school of thought held that thinning should be withheld until the eighth year (Monteath (1824) 149-54); Smith favoured thinning at five-year intervals during a twenty-year rotation (Smith (1805) 129). Gilchrist disliked this system, which he thought produced a poor and stunted crop (Gilchrist (1874) 129). Pruning and light thinning was employed between major thinnings; both Monteath and Brown advocated the application of light and careful pruning (Monteath (1824) 158-9, Brown (1861) 527-8). The methods commonly employed were not all satisfactory, however, and Walker disliked the pruning of coppice;
Gilchrist considered that close pruning of oak shoots roughened and damaged the bark (Walker (1812) V.2, 300-1, Gilchrist (1874) 129).

Although most Scottish coppice was derived from semi-natural woodland, planting was important in management. In 1759 Justice thought coppice valuable enough to plant, and until the decline of bark prices in the middle of the following century coppice remained sufficiently profitable as a crop to justify planting (Anderson, ed. (1959) 25-6). It also provided more rapid returns than large timber. In Monteath's scheme of planting the young trees were first cut over at fifteen years and again twenty years later; the third cutting after an additional twenty-four years added the new coppice to a regular rotation (Monteath (1824) 27, 118-19). The stools were therefore cut over three times within sixty years of planting and were potentially profitable for several more cuttings. Planted timber could occupy new ground or consolidate existing semi-natural coppice (Anderson, ed. (1959) 25-6). It was also of value in filling vacancies in established coppice (Smith (1805) 139); some such gaps predated management as coppice and others arose from the removal of old stools.

Planting allowed a certain element of control over the development of old unplanned coppice, which was not possible if the protection of neglected scrub, the other main means of extending the area of coppice, was preferred. Thus careful planting could introduce to old coppice an
eight-foot (2.4 m) interval between stools, which was thought best in allowing shoots to expand without encouraging diffuse and irregular growth (Monteath (1824) 113-14, Brown (1861) 527-8, Gilchrist (1874) 132). Plantation could also be used to alter species composition. In Scottish forestry oak was commonly distinguished from 'barren timber' or 'black wood', collective terms for the other native deciduous species, although ash had more value as a timber tree than the others and was occasionally ranked with oak; coppices derived from semi-natural woodland almost always contained varying numbers of stools of the barren species (Monteath (1824) 176-7). They were not unsuitable for management as coppice with oak. Birch, alder, and other common trees could be cut on rotations of twenty to thirty years; hazel was fit for cutting after eight years and cutting could therefore be designed to coincide with thinning of species on longer rotations (Gilchrist (1874) 127-8, Gilchrist (1876) 211).

When the value of oak produce rose greatly in the late eighteenth century, however, these species became less desirable. They occupied space which could largely be filled by oak, and cutting could be more efficient if coppice was laid out in blocks of separate species with different characteristics; as shall be seen later, the nature of the bark stripping season also made pure oak coppice most suitable (Monteath (1824) 176-7, Brown (1861) 512-3, below, 8.6). Until about 1850, therefore, it was
considered best to use oak when planting new coppice and gradually to alter the composition of existing wood by filling vacancies with oak and ash; there was also interest in methods of suppressing growth from stools of the barren species (Robertson (1799), 98, Whyte & Macfarlan (1811) 157, Walker (1812) V.2, 283-4, Monteath (1824) 176-9). By the middle of the century the value of oak had declined to some extent, and Brown recommended planting with species appropriate to local markets; later in the century Gilchrist considered that larch was more profitably used than oak for filling vacancies (Brown (1861) 511, Gilchrist (1874) 126).

Standards were commonly employed, although their reservation was not demanded by statute in Scotland; proprietors may have retained them largely as a source of mature timber for estate and rural purposes, but they were generally found unsatisfactory. The principal fault was that they damaged or suppressed the growth of coppice in their immediate vicinity (Monteath (1824) 171). The timber of standards was often poor and their characteristically stunted form reduced their value; as straight trees were more compatible with coppice management the valuable crooked forms of growth were not encouraged (Robertson (1799) 236). When oak coppice was most profitable the reservation of stools to produce standards was thought ill-advised; less profit was available from the sale of mature timber than from the two cuttings which would have been possible if
the stool had been coppiced (Whyte & Macfarlan (1811) 158-9). It was also noted that stools kept under management as standards for two or more rotations produced very poor crops of shoots when returned to the coppice stock (Robertson (1794) 96, Whyte & Macfarlan (1811) 158-9). Standards were therefore of little value in themselves and interfered with the growth of coppice; most writers considered that they should be employed sparingly or not at all, and it was also thought that the use of coppice as an understorey in plantation of mature timber was of little value (Walker (1812) V.2, 282-3, Whyte & Macfarlan (1811) 158, Gilchrist (1874) 120-1, Gilchrist (1876) 219).

7.6 Practical coppice management in Scotland

It is difficult to obtain evidence of the degree to which practical coppice management followed the principles outlined above, and this is especially true of the period before 1750. The absence of information is not in itself proof that management was neglected; it may be noted that some relatively early agreements indicate that both parties were familiar with a form of treatment. Thus contracts relating to south Argyllshire before 1720 required that cutting should be carried out in the customary way, and as shall be seen later contracts in Perthshire in the same period made frequent reference to customary definitions, methods, and times (SRO SC.54/12/7 [b], SC.54/12/9 [a], below, 9.3). It is therefore evident that practice was
locally standardised, although the contracts seldom contain full definitions of the relevant aspects of coppice cutting.

It is, however, evident that the quality of management changed considerably over the period in certain areas. Thus a number of writers stated that the establishment of ironworks in Argyllshire in the 1750s had improved both the value of wood and the standard of management; this was in some ways a temporary improvement and after the closure of Argyle Furnace on Loch Fyne about 1813 large areas of coppice in south Argyllshire were abandoned to the grazing of sheep (below, 11.4, 11.7). In 1811 Whyte and Macfarlan described coppice in Dunbartonshire in terms which indicate a great improvement in the quality of management after bark prices began to rise significantly (Whyte & Macfarlan (1811) 150-4).

There was also variation in the form of management in different areas of coppice at one time. This could be seen even within the boundaries of a single estate; thus a survey of the Breadalbane lands on the north shore of Loch Tay in 1769 showed a number of forms and standards of management (MacArthur, ed. (1936) 6, 24-5, 51, 57, 67). The coppice of Mull was poorly maintained at a time when the level of management in Argyll as a whole was thought to be high (Wilson (1799) 86-7); in 1793 management was improving in Perthshire in general but the coppice of Clunie
parish was said to be declining in quality and extent as the result of the greed and incompetence of proprietors and purchasers (OSAS V.9 (1793) 241). Management was generally poor in the counties where a limited profit could be expected from coppice; thus Robertson found that the level of management in Inverness-shire compared very unfavourably with that of Perthshire and other counties about 1808, when bark prices were near their peak (Robertson (1808) 208-11).

Enclosure was perhaps the most important aspect of coppice management, and also the most difficult to maintain; it was not only expensive but conflicted with the requirements of Highland pastoralism. As already indicated, proprietors could not protect coppice adequately without restricting grazing, and compromise was generally found necessary (above, 4.5). The importance of enclosure was recognised early and it was applied to coppice in Scotland as early as the fifteenth century (above, 7.4); there is also evidence of the enclosure of coppice in different parts of Scotland at the beginning of the phase of expansion in the eighteenth century. Thus in 1695 Francis Masterton requested that his coppice of oak and ash near Alloa should be enclosed with a dyke after cutting (Paton, ed. (1893) 487). In 1708 the coppice round Logierait in the Tay valley was enclosed and supervised by foresters, and ten years later it was stipulated in a contract for the sale of oak wood in south Argyllshire that timber should be left for enclos-
ure of the cut stools (EUL DC.I.37 1/3, 12, SRO SC.54/12/9 (1719)).

Most areas adopted a system in which the proprietor, tenant, and purchaser all had some responsibility for the enclosure of cut coppice. Throughout the eighteenth century coppice contracts regularly required that the purchaser should leave sufficient timber from the cut coppice to enclose the area, unless other forms of fencing were more appropriate (SRO SC.54/12/9 [a], E.777/50/1, GD.1/390 (54)); in Perthshire in the early nineteenth century purchasers were often not allowed to remove timber for sale until fencewood had been set aside (Robertson (1808) 210). Timber was supplied by the merchant either to the proprietor or the tenant and the fence was erected at the proprietor’s expense; in some instances estate labour was employed, but in others the tenant undertook the work and was compensated for his time and labour. Tenants were often obliged by their leases not only to erect fences but also to be responsible for their maintenance, a matter which not infrequently led to disputes (Robertson (1808) 209-10, Monteath (1824) 73-4, Cregeen, ed. (1964) 134-5).

Enclosure was maintained only for a limited part of the cutting interval. There was some variation in the period thought necessary for protection. In a tack of the lands of Sunart in north Argyllshire in 1744 the proprietor reserved coppice and obliged himself to enclose it for four years after cutting; at the end of the century Cameron of
Lochiel enclosed his coppice in the neighbouring part of Inverness-shire for seven to nine years. It was said that during the eighteenth century proprietors in Dunbartonshire enclosed coppice poorly and usually for no more than two years (Robson (1794) 54, Whyte & Macfarlan (1811) 150, Megaw (1963) 203). At the end of the century, however, enclosure for six or seven years was said to be most common in Argyllshire, Perthshire, Dunbartonshire, and other counties where coppice was significant; only in a few cases were large woods like those of Arrochar in Dunbartonshire excluded from farm leases and permanently protected by stone walls (Robertson (1794) 98, Smith (1805) 138, Robertson (1808) 210, Whyte & Macfarlan (1811) 151-2).

Enclosure was therefore generally maintained for a period shorter than that approved in theory, and even in the later part of the period enclosure was not universally employed even in a rudimentary form. In 1794 Robson noted that only part of the large area of wood between Inveraray and Campbeltown in Argyllshire was well enclosed, and a few years later a similar observation was made about the extensive coppices of south Knapdale (Robson (1794) 26, OSAS V.19 (1797) 321); Smith thought that management was reasonable in Argyllshire as a whole, but he noted that some proprietors did not regularly cut and enclose their natural wood (Smith (1805) 138-9). In 1794 Marshall observed that in north Perthshire woods were not maintained to a uniform standard. At that time the unenclosed woods of
Clunie parish were deteriorating but in the parish of Little Dunkeld coppice was being enclosed with stone walls; a few years later sheep were said still to be able to range through the woods of the neighbouring parish of Dunkeld and Dowally in winter (OSAS V.6 (1793) 359, V.9 (1793) 241n, V.20 (1798) 468-9, Marshall (1794) 27). Monteath thought that enclosure was still badly managed in many parts of Scotland after 1820 but rather earlier Graham had written of Stirlingshire that, in contrast to the situation fifty years previously, every enlightened proprietor planted, enlarged, and enclosed his woods (Graham (1812) 208, Monteath (1824) 73-4). It is apparent that in counties like Inverness-shire, where very little oak coppice was enclosed in any way at the time, proprietors enlightened in this sense were very rare indeed (Robertson (1808) 208-10).

Scottish coppice was generally cut within a narrow range of ages; although an interval as short as sixteen years was recorded and one badly managed coppice in Ayrshire was cut every forty years, almost all Highland coppice was cut at intervals between nineteen and twenty-five years (NSAS (1845) V.10 (Perth), 353, Anderson (1967) V.1, 467). Smith claimed that coppice was generally cut at nineteen or twenty years in Argyllshire, and the two Old Statistical Account parish reports which provide information agree with this (OSAS V.4 (1792) 473, V.5 (1793) 563, Smith (1805) 138). In Perthshire Pococke in 1760 found that large woods near Drummond were cut every twenty-five years, and
in 1794 Robertston stated that woods in south Perthshire were cut over at intervals ranging from twenty-four to twenty-six years (Kemp, ed. (1887) 240, Robertson (1794) 95). This may have taken account only of the more careful proprietors; parish reports indicate that only in two of the parishes for which information is available was coppice cut at twenty-five years and in one at twenty-four or twenty-five. In Dunkeld parish the duke of Atholl cut at twenty-five years and other proprietors at twenty; there was a similar range in two other parishes but in three coppice was cut no older than twenty years (OSAS V.5 (1793) 64, V.6 (1793) 359, V.9 (1793) 241, V.10 (1794) 611, V.11 (1794) 600, V.17 (1796) 524, V.19 (1797) 332, V.20 (1798) 478-9).

Monteath noted a tendency in the early nineteenth century to shorten the interval and cut at twenty years (Monteath (1824) 121). Intervals were not reduced in Argyllshire, where coppice continued to be cut as formerly at ages between nineteen and twenty-one years, but there appears to have been some reduction in Perthshire (NSAS (1845) V.7 (Argyll), 14-15, 112-13, 364, 502, 713). In Kinclaven coppice formerly cut every nineteen or twenty years was now cut between twenty and twenty-five but in Little Dunkeld cutting, formerly between twenty and twenty-five, was now entirely at twenty. In Comrie parish an interval of twenty-two years was employed but in Blairgowrie wood was cut as young as eighteen, and in Callander parish the cutting age
had fallen to a range between sixteen and twenty years; previously it had been cut at twenty-four or twenty-five
(NSAS (1845) V.10 (Perth), 353, 587, 908, 1006, 1134-5).

Relatively few woods were cut on full rotations; although Monteath thought that rotation was feasible with haggs as small as four acres (1.6 ha) few proprietors seem to have been willing to accept the regular but small income available from organisation of this type, and according to Nicol haggs were generally larger than ten acres (4.0 ha) (above 7.5, Nicol (1799) 299-300). A few large woods in Dunbartonshire were cut on full rotation and others were divided into a number of haggs rather smaller than the number of years in the rotation (Whyte & Macfarlan (1811) 153-4). In Perthshire woods in Comrie parish were cut in a rotation of twenty-two haggs, and the old Wood of Methven was divided into eighteen sections cut when twenty-five years old (NSAS V.10 (1794) 611, NSAS (1845) V.10 (Perth), 587). Other woods were sold in smaller numbers of haggs. Thus in 1792 Campbell of Glendaruel sold oak coppice in Cowal in three defined haggs which were to be cut in sequence (SRO GD.1/390 (54)). In other cases the division into haggs was less carefully observed; oak sold on the Struan estate in Perthshire in 1758 was divided into two sections but the purchaser was not required to cut them in sequence (SRO E.783/76/3). Small woods were usually sold whole to be cut over in a defined period, in the manner which suited the purchaser (Nicol (1799) 299-300). In Argyllshire such a system was applied.
widely to large woods which elsewhere would have been hagged; this was unpopular in making coppice timber available locally for rural use only during one or two years of the cutting interval (Smith (1805) 140-1). The working methods of the ironworks managers, who preferred to send coalers to a few sites each year rather than to a large number of small cuttings, may have contributed to this (below, 11.5).

A certain amount of attention was paid to the dressing and preparation of stools, although not always in accordance with strict principles of management. Some contracts incorporated clauses designed to ensure that stools were properly prepared and dressed. Thus in 1758 oakwood in Rannoch was sold under a contract which required that the stools should be cut smooth and clean at a reasonable height, and fit for regeneration (SRO 6.783/76/3); when mixed coppice in Cowal was sold in 1792 stools both of oak and barren timber were to be properly dressed and cut level with the ground (SRO GD.1/390 (54)). By the early nineteenth century it was generally required in Dumbartonshire, where stools had formerly been left roughly cut and two or three feet tall (61-91 cm), that they should be cut over and dressed at ground level (Whyte & Macfarlan (1811) 150). The imprecise phrasing of clauses concerning dressing permitted abuse; purchasers were able to exercise considerable discretion in interpreting them without divergence from the letter of the contract. In 1824 Monteath noted that
during his attendance of coppice sales since the beginning of the century he had seldom found the articles of sale to contain satisfactory provisions for the cutting and dressing of stools; they were still at times cut well above ground level and another practice which he disliked intensely, the stripping of bark below the cut on the stool, was also common (Monteath (1824) 122-6, Monteath (1827) 153-4).

This method was not an innovation; it had been known and disliked as early as 1758, when the contract for the sale of oakwood in Rannoch prohibited the stripping of bark below the axe (SRO E.783/76/3). When buying bark and timber on Loch Leven in 1788 the manager of Lorn Furnace in Argyllshire claimed that the company custom of stripping bark below the cut was completely harmless (NLS MS.994, 45). The practice appears to have been more commonly permitted later; in the 1790s Robertson described its adoption in Callander and other parishes of south Perthshire, where the more careful proprietors ensured that the bark was not stripped below ground level (Robertson (1794) 97, OSAS V.11 (1794) 600). Monteath and Robertson both considered the technique dangerous only if careless cutting removed all bark above ground level. Robertson thought the practice harmless and even beneficial in normal circumstances; Monteath, who disapproved of it completely, may have had less confidence in the competence and integrity of coppice cutters (Robertson (1794) 97, Monteath (1824) 124-6).
Stripping below the cut may have become more common when the increased value of bark provided a greater incentive for extraction of the maximum yield from the stool. Other aspects of site preparation were also affected by the greater profitability and larger scale of the bark trade. A longer cutting season became necessary when the area cut as coppice increased; the terminal date of oak cutting moved from the beginning of July to the middle of the month (below, 8.6). Monteath considered that the clearing of the site was of vital importance, and he attributed the poor appearance and quality of much of the coppice of Scotland to damage caused to the Lammas growth during clearance of the produce; he recognised that large cuttings might not be removed until Martinmas or even Candlemas at the beginning of February, but preferred August 1 as the date by which clearance should be complete (Monteath (1824) 141-3). This was not practicable, however; in south Perthshire in the 1790s purchasers were allowed to continue clearing to Candlemas or even until the middle of March (Robertson (1799) 237).

At the beginning of the eighteenth century the tenants of some lands were allowed to take the thin outer shoots from stools as withes (KUL DC.I.37 1/3, 10); this may be seen as a form of thinning, but formal thinning did not become common until the later part of the century. It appears to have been adopted first when it became evident that thinning not only improved the eventual crop but
provided interim income; by the middle of the century purchasers were being permitted to cut barren timber for hoops from haggs which they were otherwise not allowed to touch, and in some districts purchasers were also allowed to thin oak wood and sell the timber and bark. This was not always satisfactory; contractors tended to remove the best shoots for profit, leaving the weaker growth to provide the future crop (Whyte & Macfarlan (1811) 150-1). On the annexed estate of Perth thinning was not employed as late as 1775. George Nicolson, then a nurseryman in Callander, proposed that the foresters of the estate should thin coppice in the seventh or eighth year; the costs could be covered by the sale of the produce to tenants, who were not to be permitted to cut shoots themselves (SRO E.777/136/7).

Towards the end of the eighteenth century thinning and pruning appear to have been undertaken by an increasing number of proprietors both to provide profit and to improve the coppice. In Perthshire thinning was general by the 1790s and some coppice was thinned twice during the rotation (Robertson (1799) 240). In Dunbartonshire some time later two or three thinnings were common; even if only two were employed the second was usually valuable enough to cover the costs of both (Whyte & Macfarlan (1811) 153). The pattern of management was less regular in Argyllshire; the woods of Ardkinglass on Loch Fyne were regularly thinned before 1800 but thinning had not been
adopted in the county as a whole (Robson (1794) 31, Smith (1805) 138). Even in 1845 thinning appears to have been common only in the southern districts, although it was also practised in Ardnamurchan, which had been possessed by lowland proprietors for more than a century (NSAS (1845) V.7 (Argyll), 14-15, 150, 615, 713). The limited importance of thinning may in part be attributed to the continued importance of coalwood coppice in the north; thinning was more important if the shoots were intended for use as small timber.

It is apparent that coppice was relatively infrequently extended by planting until the late eighteenth century, but when the practice became established it remained common until the middle of the nineteenth century. In Perthshire the better proprietors were filling vacancies with oak and other species before 1800; this continued during another fifty years (Robertson (1794) 98, NSAS (1845) V.10 (Perth), 589, 1006). A certain amount of new coppice was also planted. Thus in 1822 a poor plantation of pine at Balthayock near Perth was cleared and replaced by a mixture of larch and oak, from which the larch was progressively thinned out to leave oak coppice (Ferguson (1829) 312). For about thirty years after 1810 areas of mixed wood were planted for this purpose in Monzievaird parish, and towards the middle of the century part of Lord Lynedoch's oak plantation in Redgorton parish was converted to coppice (NSAS (1845) V.10 (Perth), 166-7, 733).
The duke of Argyll and a number of other proprietors in south Argyllshire planted a large amount of new timber in existing coppice at the beginning of the century, either to augment the area of coppice or to use the coppice as nurse timber in the production of large timber (Smith (1805) 155). Associated with planting was removal of the less valuable species. Monteath observed that the clearing of barren timber had been prompted by a further increase in the price of oak bark after 1810, but the process was already under way (Monteath (1824) 177-9); removal of barren timber and encouragement of oak was recorded both in Argyllshire and Perthshire before 1810 (Robertson (1799) 241, Smith (1805) 138-9). It is possible that the process accelerated after that date, however, and there is evidence that species replacement had definite effects. In 1793 the minister of Little Dunkeld parish in Perthshire thought that the woods might benefit from the removal of barren timber; by 1845 it could be said that birch had almost entirely been replaced by oak in the parish (OSAS V.6 (1793) 359, NSAS (1845) V.10 (Perth), 1006).

Finally, it should be noted that the reservation of standards continued through the period, despite their unpopularity with coppice cutters. In some instances the proprietor selected a certain number before each cutting; in others the purchaser was expected to spare 'maidens' or
standards in relation to previous reservations or in proportion to the bark yield of the wood (SRO E.777/50/1, E.783/76/3, GD.1/390 (54)). Standards were often poor in quality; in Strachur parish in Argyll they were carefully selected but invariably proved too low in quality to be sold outside the district (OSAS V.4 (1792) 563). Walker noted that coppice purchasers permitted to select shoots for preservation as standards frequently marked the weakest, cutting the stronger shoots for immediate use; standards were seldom high in quality and a number of proprietors no longer allowed them to grow (Walker (1812) V.2, 300). By 1845 standards survived in the extensive coppices of Inveraray parish only where required as ornamental trees (NSAS (1845) V.7 (Argyll), 14-15).

7.7 The effects of coppice management

It is evident that in general management as practised in the Highlands was uneven in distribution, frequently irregular in application, and generally adopted late in the period after a period of exploitation; there are therefore grounds for agreement with Edlin's suggestion that management was, with a few exceptions, less regular and systematic than in south England (Edlin (1956) 104). The techniques applied to coppice in the Highlands, inconsistently and generally late, were not based entirely on local experience; almost all the principles followed in the Highlands were derived with or without modification
from the forms of management generally employed in England. In the seventeenth century John Evelyn described coppice management in terms which suggest that Scottish management borrowed heavily from the English tradition, and some of the earlier Scottish writers on forestry probably drew heavily on English sources (Nisbet, ed. (1908) V.2, 1-7, Anderson, ed. (1959) 3-4, 25-6).

In such a case it cannot be accepted that the slow development and irregular application of satisfactory management in the Highlands and other parts of Scotland was the outcome of a prolonged process of empirical research and accumulation of knowledge about the requirements of coppice in the region. The aspects of Scottish management which differed from those applied to bark coppice in England, such as the age of cutting, were clearly defined by the early eighteenth century (above, 7.5). Nor did the development of Scottish management depend fundamentally on the dissemination of information about new techniques; certain methods which were not apparently in general use in Scotland until the late eighteenth century were applied in parts of the Highland margin before 1700 (below, 9.2). It may be suggested that the irregular and tardy development of management in Scotland resulted largely from the failure of proprietors to treat coppice as a regular crop. Woodland was regarded as a natural resource capable of regeneration and suitable for exploitation when it became expedient; proprietors were therefore reluctant to commit
themselves to the expense of maintaining and conserving coppice until it became evident that management could enhance the profit available.

As already noted, the maintenance of formal coppice was not easily combined with pastoral agriculture of the type practised in the Highlands (above, 4.5). Coppicing could be adopted usually only at the expense of grazing, and the application of high standards of management did not necessarily raise the profitability of operations. In the more remote counties the value of management may have been outweighed by direct and indirect costs; in any case the increased value of good management might not be apparent for twenty years or more, whereas the costs of management and abatement were incurred as soon as a policy of management was adopted. It does not therefore appear unreasonable to suggest that a large number of proprietors treated coppice as a subsidiary source of profit rather than an integral part of the land use of their estates; some were genuinely interested relatively early in the sustained income available from coppice but others were encouraged to protect and manage wood only when prices rose. A third group evidently took advantage of high prices without applying any form of management.

The highest mean level of management was maintained in the southern Highland counties, which were most favourably placed to supply the bark markets of the lowlands. In the other Highland counties the profit available from
coppice appears never to have been high enough to encourage proprietors to manage their woods with a view to long-term operation. Even in the districts where management was generally most effective, certain aspects were unsatisfactory. Thus coppice consisting of barren timber was frequently cut but seldom enclosed. Woodland of birch and alder was of less value as coppice than oak; thus in Little Dunkeld parish in the late eighteenth century as much as £54 per acre was available for good oak coppice but birch coppice was worth only £2 per acre when cut at twenty-two years (OSAS V.6 (1793) 359). As shall be seen later specialised markets for barren timber arose in the nineteenth century; the more permanent of these raised the value of birch and alder coppices to more than seventy per cent of the value of oak (Brown (1861) 522, below, 8.4). Even then little attention was paid to their preservation; in Kilfinan parish in Cowal oak coppice was carefully managed but birch coppice was never enclosed and was visibly damaged by grazing (NSAS (1845) V.7 (Argyll), 364).

Many proprietors allowed the use of techniques which increased the yield of oak bark at the risk of damage to future crops. Shortening of the cutting interval may be seen as an attempt to increase the frequency and possibly the overall yield of the bark crop. At the time when this became common many proprietors also began to sell by annual roup the areas of coppice which they had formerly sold by contract for a number of years at a time; as shall be seen
later this reduced the possibility of controlling the actions of the purchaser (below, 8.5). Proprietors were also willing, especially if part of the additional profit became available to them directly or in the form of a higher purchase price, to condone the use by purchasers of methods of maximising the yield of bark and timber at the risk of damage to the coppice. Thus purchasers were allowed to abuse the conditions set for the cutting of hoops and the thinning of oak, the stripping of bark from the stool, and the selection of standards (above, 7.5).

Failure to observe different management principles had different effects on coppice. Neglect of enclosure could cause rapid and serious deterioration of coppice into a form of scrub which had no commercial value unless it was cut over and protected; it has already been noted that such scrub was common in the Highlands, persistently producing shoots which were kept in a low, tangled, and valueless form by grazing animals (OSAS V.8 (1793) 45-6, Smith (1805) 154-5, Walker (1812) V.2, 276-8). Poor dressing and preparation of stools could lead to the failure of individual stools to produce shoots and incompetent preparation might damage a high proportion of the stools in a coppice. Failure to attend to other aspects of management had less serious direct effects; bad thinning or the reservation of a large number of standards might damage an individual crop without major effects on the survival of the coppice. It was possible, however, that
within one or two cuttings the quality of the crops would be so poor that the coppice could be restored to profitable production only by a radical and expensive change in the form of management; a certain amount of coppice may therefore have been allowed to decline until it became unprofitable, and then abandoned.

In almost all cases management as coppice ceased before the beginning of the twentieth century; when this occurred deterioration into scrub was possible unless the wood continued to be enclosed for other purposes. It may therefore be said that careful management of Highland deciduous woodland as coppice could not prevent the decline inevitable under intense grazing pressure, and exploitation without adequate protection hastened the decline. In some areas the rapid disappearance of oak wood and the creation of extensive areas of poor scrub may therefore have resulted from exploitative coppicing without protection; in others the decline of oak followed the eventual abandonment of careful management and the exposure of vulnerable growth to grazing by a stock in which sheep were prominent.

There can be no doubt, however, that deterioration was delayed when good coppice management was employed. Management may in the simplest form consist only of the protection of stools against grazing for a few years after cutting; even such management was evidently sufficient to maintain the wood in a condition better than would have been possible under a regime of uncontrolled grazing and
unsystematic felling for local use. If coppice management was responsible for the decline of oakwood the fault lay primarily not in the form of management itself but in the creation of conditions which would sooner or later lead to the exposure of vulnerable growth to grazing animals and exploitation for local use; in some cases the decline of oakwood may have been accelerated by the termination of coppice management, but such a decline would have been no less inevitable if the wood had continued to be exposed to pressure from unrestrained grazing and casual exploitation.

7.8 Summary

Coppice management utilises the tendency of deciduous species to produce successive crops of supplementary shoots after felling; various forms of management may be applied to woodland of different qualities. In Scotland the principal market for coppice produce was for oak tanbark, and the oak woods of the south and west Highlands became the centre of production in a movement which reached a peak about 1800.

Guidelines for coppice management produced for contemporaries related to the form of enclosure, rotation and cutting age, site management, thinning and pruning, planting and extension and the use of standards to produce large timber. In practice, however, exploitation and poor man-
agement were common; the principles were most fully observed in the south Highlands and especially in the short period after 1790 when coppice produce was most valuable.

The late and irregular application of effective management appears to derive from the failure of proprietors to treat coppice as a crop. Although the standard was generally low coppice management can be said to have been responsible for the decline of oakwood only by permitting acceleration of a deterioration inevitable in the presence of uncontrolled grazing and casual exploitation.
CHAPTER EIGHT

TRADE IN COPPICE PRODUCE

8.1 Introduction

The trade in domestic pine timber was concerned largely with the sale of sections of straight large timber to a limited number of markets; few commercial outlets existed for the sale of irregularly-shaped wood, small timber and loppings, bark, and other wood products. In addition the strength of the established import trade was a considerable influence on the development of domestic trade throughout the period. Trade in the timber of the native deciduous species differed markedly in a number of ways. Although the sale of large straight timber was not unimportant specialised markets made some use of the characteristics of individual species and shapes of timber. Certain irregular or 'crooked' forms of individual species were in considerable demand and there were commercial outlets for small timber, loppings, and wood products; especially significant was the use of bark, charcoal, and in the later part of the period the products of other means of chemical treatment of timber.

The nature and relative importance of demand for different species and forms of timber was also much more varied over the period than in the case of pine, and al-
though certain types of deciduous timber and wood produce were imported in large quantities, the import trade was not as significant in dictating the nature of trade in domestic deciduous timber. Perhaps the most important distinction between trade in domestic pine and deciduous wood was the development of a form of integrated coppice management in the latter case. The main product was a regular crop of bark, small timber suitable for specialised use, and material suitable for chemical conversion. The deciduous timber trade was therefore theoretically broader in base than that in pine; a larger amount of the cut material could be sold and the coppice regime was flexible enough to allow modification in response to change in demand. The relatively large number of possible commercial outlets reduced the possibility that changes in market factors might relatively suddenly cancel the profitability of operations.

3.2 Development of trade in deciduous timber and bark

As in the case of pine, deciduous timber from the Highland region was used relatively early for military purposes; thus in 1615 a thousand loads of spokewood for cannon wheels, almost certainly deciduous, were cut in the Perthshire woods of Menteith (Paton, ed. (1957) 375). There is also early evidence of the movement of deciduous timber for private use. It has already been noted that in the first decades of the sixteenth century Bishop Brown of Dunkeld obtained timber from Kannon and Glenlyon
Most of his requirements were met from domestic resources; the only recorded instance of the use of imported board was in 1507, when pieces were bought for the repair of his Dundee residence (Hannay, ed. (1915) 271). He obtained a certain amount of timber from woods within a ten-mile (16 km) radius of the sites on which timber was used; in the circumstances the species employed, although not named, are likely to have been deciduous, and in one case a farm paid a regular rent in spars and planks of ash wood (Hannay, ed. (1915) 30-43, 218, 292, 293).

The burgh records of Inverness indicate that by the middle of the century the town was the centre of a certain amount of trade in timber and wood products. The regulations passed by the burgh court between 1558 and 1560 suggest a brisk trade in tanned leather and an expanding group of cordiners or shoemakers; in the following decade the court dealt with a number of cases relating to the ownership of quantities of oak bark (Mackay et al., eds., (1911-24) V.1, 27-47, 102, 145, 153-4). At the same time the court heard cases concerning timber, mainly deciduous and in relatively small forms including oak board and knapple, couples, cabbers and withies, and especially rails and 'girthstings' or hoops (Mackay et al., eds., (1911-24) V.1, 117, 123, 130, 142, 155). The nature of these forms suggests that much of the timber was used in house-building and cooperage within the burgh, but it is evident that some was exported. In 1561 the court prohibited the sale of timber to the masters of vessels arriving at Inverness
empty after discharging their cargoes elsewhere (Mackay et al., eds., (1911-24) V.1, 60).

As already indicated, such material may have been obtained largely either from formal coppice or scrub woodland (above, 7.4); there is only occasional evidence of the survival of areas of large native deciduous timber after the beginning of the seventeenth century. Thus in the middle of that century there was said to be a large oak wood at the head of Loch Eil, used profitably as a source of ship timber (Mitchell, ed. (1906-8) V.2, 159). Similarly oak woods on Loch Awe sold by the earl of Breadalbane in 1716 included a substantial amount of large oak timber for shipbuilding and other forms of construction (SHO SC.54/12/9 [b], SC.54/12/10 [a]). When John Spreull assessed the timber resources of Scotland in 1705 he claimed that the country had many large oak woods suitable for plank, crooked timber and other shipbuilding materials, staves for cooperage, and tanbark. Such woods were especially prominent in the west Highlands, and much of the bark and timber was cut for Irish use; if it was preserved it would be of value in domestic shipbuilding (Spreull (1705) 2-3, Burns, ed. (1882) 63-4).

Spreull's assessment, however, was concerned with the potential of Scottish woodland rather than its actual value at the time. He claimed that Scotland had more than sufficient pine and oak timber, if 'improved', to meet her own requirements; his own description of the country's
overseas trade indicates that although Scotland had a surplus of tanbark for export, ship timber and oak for cooperage was being imported from Danzig, Hamburg, Bremen and New England (Spreull (1705) 4-5, 12). Apart from a few instances like those indicated above, there is little evidence to suggest that Scotland had a sizeable reserve of large native oak timber. The existence of areas of mature oak and other species continued to be recorded, but the subsequent development of commercial use of Highland deciduous woodland was closely associated with bark coppice, a form of forest management which was largely incompatible with the survival of extensive stands of mature timber.

An indication has already been given of the early development of coppice management in Scotland and the existence of a number of small enclosed coppices on the Highland fringe before 1650 (above, 7.4). In the later part of the seventeenth century timber and bark were also sold from semi-natural woodland in the same districts without a history of management. There was some activity in south-west Perthshire and west Stirlingshire; the timber and bark of the island of Inchcailloch in Loch Lomond was sold by the duke of Lennox in 1647, the earl of Menteith's woods in Aberfoyle parish were being cut in sequence as early as 1675, and the wood of Ledlewan near Drymen was leased as bark coppice by the marquis of Montrose in 1698 (SHO GD. 220 [Wb.1, Wm.4, Wx.12]). The proposals of 1708 for the management of woods in the regality of Atholl on the Tay
above Dunkeld make it clear that tanbark merchants were already active in that district (EUL. De.I.37 1/3, 11-12). There is similar indirect evidence from the southern part of Argyllshire. When MacLachlan of Lephinmore sold woods on Loch Fyne in 1718 it was stipulated that the woods should be cut 'after the wonted maner of Taskers' and a similar phrase was employed when MacArthur of Inistrynich sold woods on Loch Awe in 1715; working principles for coppice cutting were evidently already locally defined (SRO SC.54/12/7[b], SC.54/12/9[a]).

The subsequent development of commercial use of Highland deciduous woodland was very closely associated with the extension of tanbark coppice, and the form of development was largely determined by two related factors, the nature of the coppice system adopted as the best means of bark production and the demand for domestic tanbark. The nature of Scottish bark coppice has already been examined (above, 7.6); the relative strength of the tanning industry, the level of prices and the availability of alternative tanning materials were also important. During the eighteenth century the cutting of woodland as coppice intensified in established producing areas and extended to others; bark coppice was a relatively flexible system of management and in the period of peak demand production was increased by enlargement of the area of native wood under management, planting of suitable timber, and use of the less valuable barks.
8.3 Production and sale of bark

As already noted, a variety of vegetable tanning agents was used in domestic tanning in the Highlands, including a number of tree barks (above, 3.6). A smaller range of agents was employed in commercial tanning; the tannin content of different barks varies markedly and the agent employed also has a considerable effect on the quality and appearance of the finished leather. For these reasons, oak bark was generally found most suitable; it has a higher average tannin content than birch, willow, hazel and other native barks; alder bark may be richer in tannins than oak but produces a brittle and unacceptably dark leather if used alone (Howes (1953) ix, 6-7, 112-113, 119, Aaron (1970) 8). Although other barks were used commercially oak bark was until the second half of the nineteenth century the most important vegetable tanning agent in British use (Howes (1953) 10).

In broad terms the British tanning trade formerly consisted of two divisions catering for different markets. 'Heavy leathers' for soles, harness and belting were generally prepared from cattle hides by vegetable tanning, almost invariably using oak. 'Light leather' for shoe uppers, gloves, and other leather goods requiring softness and flexibility was usually made from the skins of the smaller domestic animals by mineral tanning or tawing with an alum solution; skins thus prepared and preserving their natural
colour were known as 'white leather'. These divisions were not rigid; calfskins were at times prepared by mineral tanning and certain barks, including those of birch and willow, were of value in the production of light leathers (Howes (1953) 12-13, 112-113).

The leather trades were recorded relatively early in the Scottish burghs; in Edinburgh the corporation of cordiners was founded about 1450 and that of the skinners in 1536, while the existence of a community of cordiners and a trade in oak bark in Inverness in the sixteenth century indicates that the tanning trade was not confined to the lowland burghs (Bremner (1869) 351-2). Tanning or 'barking', however, appears to have remained an unregulated trade, primarily for immediately local consumption, until the end of the seventeenth century; much of the Scottish production of hides and skins was exported uncured and in the early seventeenth century hides and skins were the country's most valuable export (Smout (1963) 237). There is evidence of the fragmented and unsatisfactory state of Scottish tanning in this period; in 1617 the cordiners of Edinburgh submitted a petition to parliament concerning the tanners and the matter was passed to privy council for investigation (APS V.4 (1816) 557).

The cordiners alleged that Scottish tanners were so incompetent and wasteful that it proved more practicable to have hides sent for tanning to the towns of the north of England and illegally returned to Scotland. In statements
to privy council the cordiners and representative tanners from the principal burghs agreed that the deficiencies of the Scottish tanning trade resulted largely from its open nature, and proposed that tanning should be practised only by freemen of free burghs under the supervision of inspectors; the principal tanners, who almost certainly wished to monopolise the Scottish trade, alleged that the standard of production was lowered by the activities of unskilled men working both in the burghs and landward areas, and proprietors who tanned for themselves and their tenants (APCS Ser. 1 V.12 (1895) 160-3, V.13 (1896) 643).

Although privy council did not sanction the restriction of entry to the trade, in 1619 it approved the inspection of tanned leather and the employment of a group of English tanners to instruct Scottish craftsmen. Sir John Erskine was granted a monopoly of leather production, with oversight of both the inspectorate and the instructors; during the following decade the instructors travelled round the country and Erskine brought proceedings against many tanners who refused instruction. Some were resident in the burghs; according to a complaint of 1623 the new regulations had forced twenty men out of business in Perth, and smaller numbers in the other burghs of the Highland fringe. A large number of the uncooperative tanners, however, worked in hamlets and farms throughout rural lowland Scotland and the Highland fringe (APCS Ser. 1 V.12 (1895) 170, 304-7, 670, 692, 746, V.13 (1896) 242-8).
It is evident that a large number of individuals were engaged in tanning, although production in most cases was probably small and the trade lacked any formal organisation.

The cordiner's grievance was concerned mainly with the quality of oak-tanned leather; similar objections made in the late sixteenth century about the methods of preparing 'dry' or tawed leather had resulted in great improvement both in the quality and quantity of Scottish tawed leather (RPCS Ser. 1 V.12 (1895) 162). By 1700 Scottish vegetable tanning appears to have become a more stable and concentrated trade; this is indicated by the increased evidence of the cutting of bark coppice in the second half of the seventeenth century, while the relative importance of uncured skins among Scottish exports had declined to some extent and the skins of sheep, lambs, goats, and kids had become more significant among the exports both proportionately and in absolute terms (Smout (1963) 217-19, 237, above, 8.2). This suggests that domestic vegetable tanning of heavy leathers from cattle hides had become more important, but the general decline of the trade in uncured hides and the increased importance of the lighter skins may also be explained in part by the increased export of live cattle during the century.

By 1700 there was a small export of prepared leather to the Baltic and other European destinations consisting mainly of white leather and gloves. The volume of this
trade increased appreciably between the 1670s and the decade before Union, but in the same period Scotland imported a large amount of tanned leather, especially from Ireland and England; over sixty per cent of the import was from Ireland, but tanned leather was the most valuable raw material import from England in the later part of the century (Smout (1963) 181, 203-4, 236, 285). Protection was thought necessary to encourage domestic tanning. Governmental protection had previously been given mainly to the producers of gloves and white leather; in the late sixteenth century the export of the smaller skins was prohibited to assist the skinners, and similar restrictions were continued in the following century for the benefit of glovers and white leather makers (Bremner (1869) 351-3, Smout (1963) 217).

Shortly before Union there was some pressure to obtain protection for the tanners. Anti-Union pamphleteers included tanned leather among the imports from England regarded as costly and unnecessary and in 1705 an act prohibiting the import of Irish or English tanned leather reached the initial stages (Smout (1963) 267, APS V.11 (1824) 216a, 238b). In November 1707, shortly after Union, the convention of Royal Burghs approved a proposal that tanning should be protected and encouraged by prohibition of the export of bark (Marwick, ed. (1866-80) V.4, 430). In the decades after Union the strength of the Scottish tanning trade appears to have increased steadily and by the 1730s the urban tanners were well enough organised to impose their own conditions on the
suppliers of raw materials.

The bark-producing districts were largely dependent on the major burghs as markets. In the case of Perthshire bark this can be seen in the specification, in some contracts, of points to which estate tenants were required to carry bark. Thus in 1680 the bark of Kincardine wood near Auchterarder was to be taken to Stirling, Alloa, or points equally distant, and in 1698 the purchaser of Ledlewan wood in west Stirlingshire was allowed carriages to Linlithgow or Bo'ness (SRO GD.220[Wk.3, Wk.1]). In the first decade of the following century bark from the regality of Atholl was transported to Perth, Coupar Angus, and Forfar (BUL Dc.1.37 1/3, 13); in the following fifty years the tenants of Aberfoyle parish in south-west Perthshire carried bark to Glasgow, Manor Neuk, or a similar distance (SRO GD.220 [Wm.7, Wm.13, Wm.32]); Manor Neuk, on the Forth immediately east of Stirling, was probably a shipping point for destinations lower on the Forth. In 1754 a bidder for the woods of Comrie parish required carriages to Perth, Kinross, and Alloa, which he and his father had served during the previous twenty years (SRO E.777/50/1).

Although the burghs supplied the largest commercial outlet it is evident that some bark was still supplied to small tanners serving rural areas in the lowlands and Highland fringe. The form of contracts admitted the possibility that bark might be taken to any point within a certain distance, although specific destinations were named; in
a memorandum on the sale of the woods of Aberfoyle parish noted that the small tanners, although unreliable, offered higher prices (SRO GD.220 [Wm.24]). About ten years before the major tanners had joined together in an attempt to lower the price of bark (SRO GD.220 [Wd.3]); if the small tanners were working independently in small towns and villages relatively close to the source of bark and outside the burghal organisation some explanation is provided both for their unreliability and their willingness to pay higher prices.

North and west of the Highland margin tanning and shoemaking remained rural crafts and provided little local commercial market for bark. Thus in the Tay valley around Logierait in the early eighteenth century tenants tanned hides for themselves, which were later cut and worked in their homes by travelling 'country shoemakers'; it was noted at the time that Dunkeld on the Highland margin was locally the southern limit of operations of these craftsmen (EUL Dc.I.37 1/3, 13). In other parts of the Highlands, especially the more remote areas, the population continued not only to tan but to make its own shoes; this was still the case in many parts of Perthshire and Argyllshire at the end of the eighteenth century (above, 3.6).

In the late eighteenth century bark prices began to rise sharply and commercial tanneries were established in a number of small towns near the sources of oak bark; until that time tanning had remained almost entirely in the burghs.
In Perthshire established markets remained in use and increased in importance; in the 1790s bark from Clunie parish went to tanners in Dundee, Forfar and Brechin, and bark from Dunkeld went to Dundee, Forfar and Perth; the bark of Callander parish was sent to the tanners of the Forth (OSAS V.9 (1793) 241, V.11 (1794) 12, V.20 (1798) 478-9). Nevertheless new markets appeared; by 1778 Dunkeld had three tanneries specialising in shoe leather and in 1781 a new works was built in Coupar Angus (Loch (1778) 54, OSAS V.17 (1796) 6). Two more were founded in Crieff in the 1780s, one of them under the auspices of the annexed estate commissioners, and in the south of the county tanning was by 1793 the staple employment of the small town of Thornhill in Kincardine parish (SRO E.777/47/1, OSAS V.6 (1793) 483, V.9 (1793) 593). From Argyllshire bark went largely to Glasgow and the upper Clyde, but tanneries were opened in Oban and Campbeltown about 1790 (Robson (1794) 22, Smith (1805) 305, below, 11.6).

Expansion of tanning on a commercial scale into small towns occurred at a time when major changes were initiated in other aspects of the tanbark trade, as is evident from the trends in bark prices. Price structures in the bark trade in some ways resembled the system of fiars prices for victual. It is evident that each year the tanners of any one market town agreed more or less formally on the basic price of bark delivered to the tanyards or convenient points in the locality; prices were
set before the beginning of the cutting season and were consequently influenced strongly by those of the preceding year (Monteath (1824) 148-9). Prices also appear to have been agreed for the bark of inferior oak such as thinnings and that of the other species employed. Knowing the scheduled delivered prices, proprietors and bark merchants were able to determine selling prices for specific coppices which would take into account, if necessary, transport costs from the woods to a given market.

Information about the sequence of prices over a period has unfortunately not survived, and evidence about changes in price is largely fragmentary; another difficulty in comparison of prices lies in the range of measures employed. Before the end of the eighteenth century the most common measure was the boll, but although an attempt was made in 1696 to provide a legal standard for the bark boll measures consisting of eight or ten stones 'dutch' weight were in use throughout the following century and there is some evidence of a twelve-stone boll immediately before 1700 (SHO GD.220 [Wx.1], APS V.8 (1820) 608). The dutch stone, equivalent to approximately 17.5 pounds avoirdupois (7.9 kg), was commonly used in the later part of the eighteenth century, although the ten-stone boll was still the basic measure in parts of the Highlands some time after 1800 (Monteath (1824) 300).

Although used as a bark measure in customs records by 1755, the ton seems to have been adopted in the bark
trade in general only when cart haulage and water carriage made it easier to reckon bark in quantities larger than could be carried by packhorse. For comparative purposes prices stated in terms of bolls are most conveniently standardised in pounds sterling and divided by eight or ten as appropriate to provide a price per dutch stone; when the size of the boll in use is uncertain two prices per stone are stated to correspond to both common bolls. Prices stated by the ton are not converted to prices per stone, although overall standardisation in terms either of stones or tons would be desirable. The imperial ton was equivalent to 128 stones of 17.5 pounds avoirdupois (7.9 kg), but it cannot be assumed that the measures employed were consistent; multiplication and division by a factor of 128 would therefore introduce a considerable possibility of error.

In the late seventeenth century a boll of bark from the Montrose lands in the south Highlands could be sold for 3/4d. sterling (4d. or 5d. per stone) in lowland markets, but prices were lower at the beginning of the eighteenth century (SRO GD.220 [Wb.2]). Prices later made a substantial recovery and by 1735 tanners in the Glasgow district were paying 9d. or 10d. per stone (SRO GD.220 [Wb.3]). A peak may have been reached rather earlier; in 1718 bark was sold prepared but undelivered in south Argyllshire for 9s.6d. or 1/0d. per stone, and in Inverness in the same year a price of four merks per boll (5.3d. or
6.6d per stone) was thought reasonable for the inferior bark of birch (Paton, ed. (1913) V.1, 166, Mackay, ed. (1915) 89).

In 1735 or shortly afterwards, it was claimed, the tanners made a concerted and successful effort to reduce the price of bark; in the Glasgow district the price fell sharply to 6d per stone and remained as low as 7d in 1757 (SRO GD.220 [Wb.3]). Price control by the major tanneries could be circumvented with difficulty by the sale of bark in districts where prices were more favourable; one merchant working in the Loch Lomond district claimed in 1757 that he could get 8d per stone by selling his bark in more distant markets, but it is probable that at least part of the additional value of this bark was cancelled by increased transport costs (SRO GD.220 [Wb.3]).

A relatively small but apparently consistent quantity of bark was also exported to Ireland in this period, although Irish tanners generally used cheaper but less effective bark from north Germany; the price of domestic bark appears to have been rather higher in Ireland than in Scotland in the 1770s, and remained slightly higher during the period of peak prices (SRO RH.2/4(10), 11, 32, 49, 65, RH.2/4(14) 89, RH.2/4(12) 23, McCracken (1971) 80). Small tanneries paid higher prices; although in 1743 bark from Menteith was thought to be worth only 6.2d if sold in established markets, the small tanneries would pay as much as 7.5d (SRO GD.220 [Wm.24]).
Prices rose to some extent after the 1750s and in 1761 the market value of Menteith bark in the Stirling market was 8d or 10d per stone (SRO GD.220 [Wm.33]). Until the beginning of the last decade of the century, however, prices rose little above the level reached in 1735. The unprecedented price increases recorded after 1790 may indicate both a direct response to a higher level of demand and the effects of a period of severe national inflation which continued from about 1793 to 1813 (Hobsbawm (1968) 235-6).

It is unlikely that demand remained almost entirely unchanged between 1735 and 1790, however, before increasing greatly in the wartime conditions of the 1790s; it is possible that the major tanners were able to impose controls on bark prices until the economic conditions of the late eighteenth century brought about a marked increase in requirements which disrupted a stable pattern of supply and prices. In 1787 Knox observed that bark was increasingly valuable, selling at 1/0d per stone, but prices rose further within the next few years (Knox (1787) 13). By 1794 Perthshire bark could be sold to Stirling and the Forth tanners at prices between 1/2d and 1/6d per stone (OSAS V.10 (1794) 125, V.11 (1794) 600). Prices in the bark markets of Perthshire and Angus were apparently generally at a lower level but they also increased during this period; in 1793 the Angus tanneries still paid only between 10d and 1/0d per stone, but five years later it was recorded that prices in the Perthshire and Angus towns had risen in a few years from 8d to 1/3d per stone (OSAS V.9 (1793) 241, V.20 (1798)
Later prices are generally available in terms of tons; a price of 1/0d per stone Dutch weight was approximately equivalent to £6-8s per ton. The level of prices continued to rise and reached a peak after 1810. In 1787 the manager of Lorn Furnace in Argyll thought £4-0s per ton exclusive of preparation and carriage costs an unreasonably high price for the bark of standing oak near the company quay; in 1812 the company made an initial offer of £10-0s per ton on the same conditions when the same coppice was again due for cutting (NLS MS.994, 12, MS.995, 86). In 1790 a ton of bark could be sold in the Glasgow district for £5-0s or £6-0s but by 1795 £12-12s was paid per ton (Smith (1805) 138, Whyte & Macfarlan (1811) 154-5); a brief depression in the bark market arrested the price advance in the late 1790s and in 1797 the delivered price at the Broomielaw in Glasgow was as low as £8-5s (NLS MS.993, 53, Robertson (1799) 238-9). By 1809 prices had touched £18-0s and the Broomielaw price stood at £17-0s per ton (Graham (1812) 212, NLS MS.995, 79); another minor decline brought the Broomielaw price down to £14-0s in 1811, but between 1812 and 1814 prices between £18-0s and £20-0s were common (NLS MS.995, 82, Monteath (1824) 177).

In summary, prices for domestic oak bark doubled between the end of the seventeenth century and 1735, although increase was not at a constant rate. From then until about 1790 price levels remained low, perhaps partly as
the result of control by the major tanners, but prices trebled during the period of peak demand for domestic bark in the quarter century after 1790. During this period the inadequate supply and high cost of domestic oak bark encouraged the employment of a variety of substitutes (Walker (1812) V.2, 257). Experiments were carried out with oak sawdust and with materials previously used in domestic tanning in the Highlands, including heather and certain leaves, but barks of other species were more commonly used (Bremner (1869) 354). This was not unprecedented; in the early eighteenth century some contracts included the bark of birch and rowan, and there was a certain amount of trade in birch bark among the Highland burghs, although oak fetched higher prices and was never mixed with other barks (SRO SC.54/12/11 [b], Mackay, ed. (1915) 89). In the later period birch bark appears to have been the most frequent substitute, although the price was generally only half that of oak and the necessity of removing the valueless outer bark added to the merchant's operating costs (Monteath (1824) 139-40, 251, 298-9). Other domestic barks of semi-natural and planted species were also employed, including rowan, willow, and Spanish chestnut; only chestnut bark could be sold at prices approaching those of oak (Monteath (1824) 251, Robertson (1794) 97, Graham (1812) 210).

After 1815 the general market price of oak bark declined slowly, remaining above £14-0s between 1817 and
1819 but falling below £13-0s after 1821 (Monteath (1824) 250-1). Although in 1816 merchants paid £11-15s per ton for unprepared bark at auctions on the Montrose lands, auction prices fell to £8-15s by 1826 and £7-0s by 1833 (SRO GD.220/6 (56) (1816, 1826, 1833)). By 1860 the average market price of oak bark had declined to £6-0s or at most £8-0s per ton (Brown (1861) 528); such a price had been satisfactory before the increases of the 1790s, but production costs had increased and domestic oak bark no longer dominated the market. Alternative domestic sources of bark had declined into insignificance by the middle of the nineteenth century, although some larch and birch was still stripped (Brown (1861 529). The main challenge came from imported oak bark. Dundee and other Scottish ports were receiving shipments of English bark by the beginning of the seventeenth century, and a coastal trade in English bark may have continued in the eighteenth century (Lythe (1960) 44, 224). As late as 1785, however, the recorded import of bark from overseas was only four tons (4.0 t) (SRO RH.2/4 (24), 7).

Larger amounts were imported from overseas in the following decades, mainly from western Germany and Norway; more than 800 tons (813 t) were brought in during 1795 and a similar amount in 1805 (SRO RH.2/4 (26) 11, 14, RH.2/4 (34) 22). In 1815 an additional import from Holland raised the total above 1,200 tons (1,219 t) and by 1825 the annual import of bark had risen above 6,000 tons (6,096 t),
supplied largely by Holland and Flanders (SR0 RH.2/4 (42), 27, 31, 40 RH.2/4 (52), 9-25, 29, 34). By the middle of the century imported oak bark was very significant in the Scottish market and the value of oak coppice was declining steadily (Brown (1861) 529). When Gilchrist wrote in the 1870s tanbark coppice of oak was still extensive in the southern Highland counties but decreasing in value, and the other native deciduous barks were no longer of commercial value (Gilchrist (1874) 118, 132, Gilchrist (1876) 210-220). By that time imported substitutes for oak bark had been widely adopted in the British tanning trade; the use of oak bark became restricted to the production of certain high-quality leathers and it now accounts for only one per cent of British vegetable tannin consumption (Howes (1953) 10, 21, Aaron (1970) 7).

The period of peak bark price coincided with a period of exceptional price movements and vigorous economic activity in Britain as a whole, but the rise in prices cannot be attributed entirely to inflation; inflation was certainly severe, and Brown and Hopkins have shown that the price of consumables in England rose by about 115 per cent between 1790 and 1813, but during the same period the price of bark in the Glasgow market increased by 230 per cent (Brown & Hopkins (1956) 313-4). Scotland continued to export bark in small quantities to Ireland until at least 1795 but the domestic supply appears to have been insufficient to cope with a sudden increase in demand (SR0 RH.2/4 (26), 56).
Coppice operation was flexible but not adaptable enough to permit a substantial short-term increase in oak bark production, and in the south Highlands marginal coppice had already been converted to sheepwalk. Overseas imports and inferior substitutes appear to have done little to arrest the upward trend in prices. The poorer barks were not suitable for some tanning processes and imports were still limited in quality in 1815. The difficulty of maritime trade in war conditions and the general European demand for leather for military use in this period may have restricted the quantity available to Scotland. There was also a rapid price rise in England between 1790 and 1812, followed by a decline when European oak bark was imported in large quantities (Jones (1959) 216); it is evident from this that the British Isles as a whole suffered some shortage of bark during the wars, and that England was not in a position to supply oak bark to Scotland.

A secondary use of tanbark may also be mentioned. It has already been observed that in the Highlands sails, fishing tackle, and nets were preserved by the use of a bark solution (above, 3.6); oak was used but birch bark was preferred (Blaikie (1829) 366). A similar means of preservation was used in commercial fishery; under the system of bounties operated between 1750 and 1830 to encourage herring fishery one of the conditions of eligibility was that vessels should carry sets of tanned nets (Jenkins (1920) 114-15). Although such a use can never have been
much more than a minor market for bark, it probably had local significance in parts of Argyllshire and other areas where fishing fleets were based close to the source of bark. Thus in the 1830s oak bark from certain farms on Loch Fyne could be sold for this purpose at prices higher than those paid by the tanneries, and the cost of transport to the shore was very low (Monteath (1827) 15).

8.4 Production and sale of timber

Bark was the most valuable coppice product but timber also had a significant role in the coppice economy. Measurement was a basic part of the process of valuation in the sale of standing timber and certain dimensions were accepted as the minimum suitable for specific purposes. The purchase prices of auction lots of timber were determined largely by the quantity of 'measurable timber' of this type. Smaller material was made available for local use or discarded at the discretion of the purchaser, who was generally granted the small timber and brushwood to offset the costs of marketing the more valuable material. For most purposes the lower limit of the range of measurable timber was assumed to be a diameter of six inches (15.2 cm) or a side (i.e. the side length of a cross-section of timber after squaring) of four and one half inches (11.4 cm) (Monteath (1824) 243). Wood of smaller dimensions was not included among measurable timber but was commercially acceptable for certain purposes; thus oak wood for
spokes was measured down to three inches of side (7.7 cm) and barrel timber to two and one half (6.4 cm), while ash wood for tools might be saleable as small as one inch in diameter (2.5 cm) (Monteath (1824) 243, 246-7, Thomson, ed. (1864) 6).

Bark coppice provided little timber which was measurable in the general sense; Monteath estimated that no measurable timber could be expected from such coppice unless cutting was delayed until later than the twenty-fifth year (Monteath (1824) 262-3). On some estates a supply of measurable timber was maintained by plantation or the reservation of areas of semi-natural wood from coppicing, but such timber was available from coppice itself only when an area of established semi-natural wood was first cut over, or if standards were reserved within the coppiced area.

The general employment of a form of coppice-standards management has already been indicated; standards were generally of little commercial value, although they provided a useful supply of measurable timber for local consumption (above, 7.6). Examples of the cutting of mature woodland may also be found. A number of woods on Loch Awe appear to have been cut over first between 1710 and 1720; the purchase of wood on the north shore in 1710 by a Glasgow joiner indicates that the timber was of some value in itself and the sale of the Breadalbane woods at the north-east end of the loch in 1716 yielded both bark and a sizeable quantity of oak timber for shipbuilding and millwork, including knees and other crooked forms more
likely to occur in mature timber than in coppice (SRO SC. 54/12/7 [c], SC.54/12/10 [a]).

Until the later part of the eighteenth century emphasis was almost entirely on the value of bark when coppice was sold. As early as the beginning of the seventeenth century carriages of bark were guaranteed in contracts for the sale of coppice but such carriages were rarely extended to include the transport of timber (SRO GD.220 [Wx.1]), Innes, ed. (1848) 294-5. Valuations and purchase prices were determined largely by the estimated quantity of bark and the current market price. This was the case on the Montrose lands in the late seventeenth century, and although in some valuations account was taken of the presence of mature trees the assessment of the woods of Menteith in 1752 was still simply an estimate of the likely yield of bark, from which a purchase price was calculable in relation to the value of bark in accessible markets (SRO GD.220 [Wm.18, Wm.31]).

Although of minor importance in itself the disposal of timber could determine the profitability of a contract; the timber available after stripping had a definite role in defraying the costs of manufacture and carriage. Thus in 1743 certain woods in Menteith were valued and a selling price estimated which was the exact equivalent of the estimated value of the bark to the merchant; a lower price would be accepted only from a trustworthy purchaser (SRO GD.220 [Wm.20]). In this case the value was set at 4.5d
per stone, although other estimates made in relation to these woods at the time were based on a market value which was on average 6.5d per stone (SRO GD.220 [Wm.24, Wm.25]). The purchasers of the Menteith woods were not at the time permitted bark carriages to cover transport costs and the 1743 value was said to have been reduced because of the cost of carriage; the converted value of tenant carriages was approximately 1.5d per stone, which accounts for most of the difference between the estimates (SRO GD.220 [Wm.24, Wm.25]).

Payment to the proprietor and the cost of transport therefore together represented an outlay of 6d per stone, and the merchant also had to pay the cost of bark preparation, which amounted to 1d per stone (SRO GD.220 [Wm.25]). If the market value of bark was only 6.5d per stone it is clear that he could operate profitably only if another source of income was available; this was provided by the sale of timber and 'bounty bark', a concession which at the time was equivalent to one free boll of bark in every twenty. It appears to have been general practice in the southern Highland counties to reckon the value of a sale primarily in terms of bark and set the value of timber against operating costs; this method of calculation was still employed in Perthshire in the late eighteenth century (OSAB V.5 (1793) 64). In general commercial markets for coppice timber were restricted in distribution and transport costs were prohibitive in relation to value; any carriages
allocated to the merchant were better employed in transporting the more valuable bark to the burghs.

Some concession was necessary when the timber was low in value. In Menteith the value of wood was in fact insufficient in itself to cover manufacturing costs; although bark preparation cost 1d per stone in the 1740s estimates of the value of timber ranged from 0.33d to 0.77d (SRO GD.220 [Wm.24, Wm.25]). When the woods in question were offered for sale in 1743 while the bark market was depressed, the sole prospective purchaser refused to pay the proposed price as he had received an independent valuation which included an unfavourable assessment of the available timber. When other woods in Menteith were valued in 1752 it was noted that the value of the timber was 4d per boll (0.5d per stone) less than the proportionate cost of preparation of bark (SRO GD.220 [Wm.31]). The timber of Menteith was still insufficient to balance manufacturing costs in the 1790s (OSAS V.10 (1794) 125).

In Argyllshire there was an accessible market for coppice timber in the form of coalwood for ironwork, especially after the establishment of two major works in the 1750s (below, 10.6). There are also a few early instances of the sale of Perthshire coppice timber to markets some distance from its source; thus the author of the proposals for the regality of Atholl complained in 1706 that the timber was not made available locally, but was instead burned or carried to Perth, Coupar Angus and other burghs
(BUL DC.I.37 1/3, 11-12). Until the late eighteenth century, however, it seems to have been more usual for the timber to be sold or otherwise disposed of locally. Coppice wood was suitable for many rural uses, including the replacement of the major roof timbers; thus for some years in the middle of the eighteenth century the purchasers of the Menteith woods were obliged to supply couples, roof-trees and pantrees from the coppice timber at set rates of compensation (SHO GD.220 [Wm.26]). There is little evidence that merchants were able to take advantage of captive rural markets during operations; as already indicated proprietors employed in contracts a variety of reservations designed to protect their own and their tenants' timber supply, and in any case coppice cutting as practised in the Highlands frequently produced an intermittent surplus of small timber rather than a small and controlled supply (above, 3.3).

In the late eighteenth century commercial markets for coppice timber improved; increased demand coincided with the loss of a major source of supply for certain forms during the American War of Independence. Marked increases in the price of Highland wood were recorded and the equation of operating costs with the value of timber therefore became unrealistic (Allardyce, ed. (1888) V.2, 243n); by the beginning of the nineteenth century there was evidence of change. In Dunbartonshire it had formerly been assumed that operating costs would be met by the profit on timber
and that the price of bark would provide payment to the proprietor and a profit for the merchant; by 1811 timber provided a profit even after meeting the increased costs of bark production, and a similar situation was recorded in Stirlingshire (Whyte & Macfarlan (1811) 155, Graham (1812) 212). As further commercial markets for coppice wood opened the customary means of reckoning appears to have been found inappropriate and gradually abandoned.

Certain markets for coppice timber were available throughout the period, but increased in importance toward the end of the eighteenth century. Thus the relatively small demand for peeled coppice wood as fuel increased as peat became less accessible and more expensive in time and effort (above, 3.5). A certain amount of coppice wood of measurable quality was sold to local craftsmen at most times. Full-time craftsmen were not common in the Highlands at the beginning of the century; thus in the Tay valley part-time timberworkers travelled between their customers' homes, using the householders' own materials (EUL Dc.I. 37 1/3, 11, 13, 18). Such trades gradually became more specialised and centralised; by 1780 a limited number of wrights were working in the upper valleys of the Tay system, and by 1845 two sawmills near Kenmore on Loch Tay were preparing small timber both for country use and industrial markets outside the Highlands (NSAS (1845) V.10 (Perth), 775, above, 6.5).
The use of coppice wood for purposes outside the rural economy therefore developed throughout the period, and there was also a certain degree of regional differentiation. In Argyllshire the principal demand in the eighteenth century was for charcoal, especially for iron smelting. Some smelting was carried out in the county before 1740 but the main market was provided by the furnaces established after 1750 at Furnace on Loch Fyne and at Bonawe on Loch Etive (below, 10.6). Most of the coppiced woodland of the county was economically accessible to one or both furnaces and most of the timber was suitable for coaling. In modern charcoal production all the common deciduous species are employed; all the timber can be coaled, although logs over seven inches (17.8 cm) in diameter carbonise slowly and irregularly and use of the smallest wood entails disproportionately high handling costs (Reynolds (1961) 4). This was also largely true of the Argyllshire operation; although the bulk of the coppice timber was of intermediate sizes and readily coaled, the Lorn Furnace Company found it more profitable and convenient to sell measurable timber whole, and in some contracts was not obliged to cut scrub or brushwood (below, 11.5).

By the end of the century the importance of the two furnaces in the wood economy of the county was recognised and they were given credit for providing an incentive to the careful management of woodland resources (Smith (1805) 137-8, Walker (1812) V.2, 208, OSAS V.5 (1793) 298). It
was also noted, however, that the keen demand for coalwood and the local practice of cutting coppice in large blocks rather than annual haggs led to serious local shortages of timber for rural use and exceptionally high prices (Smith (1805) 138, 141, OSAS V.11 (1794) 280-1). The peeled oak timber which in other parts of the Highlands was available as domestic fuel appears largely to have been coaled; some of the better timber was sold to Glasgow merchants or the northern Irish ports by the iron companies or independent timber merchants (SRO GD.1/390 (54), below, 11.4, 11.6). Boatbuilding, house construction, and other timber crafts were carried out in the growing town of Oban in mid Argyll, but there were few other local markets (OSAS V.11 (1794) 135, below, 11.6). The available supply of local timber appears to have been insufficient even for these modest demands, and the county was importing Welsh and Norwegian boatbuilding timber by the end of the century (Smith (1805)141).

Attempts to establish iron smelting in Perthshire failed and the use of charcoal was never as important in that county as in Argyllshire (below, 10.5). A limited amount was required by the forges operated in association with the Carron works and other lowland coke-smelting furnaces in the second half of the century; Perthshire charcoal was also used by foundries which did not produce their own metal, although by the end of the century it was being replaced for this purpose by coke (Campbell (1961) 50, 204, Robertson (1794) 96-7, below, 10.6).
Limited as it was, the coaling of wood in the county aroused fears that little timber would remain for local use; when the Carron Company showed interest in woods on the annexed estates of Perth in 1764 there was some local concern and the management found it expedient to assure the commissioners that no serious shortage or even inconvenience would be caused (SRO E.777/133/2).

There can be little doubt that when a regular demand for charcoal was established the relative value of timber was greatly increased and coppice management as a whole became more profitable; Argyllshire therefore had some advantage over Perthshire in the second half of the eighteenth century. The following instance indicates the value of coaling as a means of disposing of timber. In 1790 the Lorn Furnace Company sold bark to the tannery at Oban for £6-0s per ton put on board ship; transport of bark from mid-Argyll to Port Glasgow at that time cost about 15/0d per ton, and it is reasonable to assume that the rate for the ten-mile (16km) journey from Stonefield Bay on Loch Etive to Oban was no more than 10/0d per ton. This suggests that the local market price for bark was no more than £6-10s per ton (NLS MS.994, 117, MS.995, 2).

At the time the company was willing to pay £1-8s per dozen for charcoal delivered at the furnace quay; the delivered price of five dozen was therefore rather more than the local delivered price of a ton of bark. Unfortunately there is no set relationship between the charcoal and bark yields.
of a given area of woodland and contemporary estimates varied markedly. Thus in 1788 one area which perhaps contained relatively little oak was estimated to contain twelve dozens of coals per ton of bark, but in 1789 another area was assessed as containing only three dozens per ton. In the latter case the relative importance of bark was raised by the inclusion of 1,000 mature oaks as a source of bark and mature timber rather than charcoal (NL5 MS.994, 52, 71).

Even if a ratio of charcoal to bark as low as three dozens to the ton was general, the value of the timber of an area of woodland would still be more than sixty per cent of that of bark in the terms stated above. In Menteith, however, no markets were available for charcoal in the 1740s, when the quantity of raw timber available per unit of bark was calculated to be worth only about eleven per cent of the market price of the bark in two separate estimates (SR0 GD.220 [Wm.24, Wm.25]). Charcoal was more stable in price than bark; by the end of the century the two Argyllshire ironworks served a small and specialised part of the iron industry and cooperated to keep down the price of charcoal (below, 11.4); the tanning trade was large, competitive, and apparently no longer able to control the prices of its raw materials. Between 1790 and 1813 the price of charcoal in Argyllshire increased little more than twenty-five per cent but the price of bark generally doubled; even so, in 1812 Walker estimated that
in districts where both could be sold, charcoal was still worth half as much as bark in a given area of Highland coppice (Walker (1812) V.2, 291-2).

Towards the end of the eighteenth century a new and regular demand for coppice oak timber appeared, providing a market for the produce of Perthshire and other counties unaffected to a significant extent by the demand for charcoal. As the Scottish road system improved increasing numbers of carts, carriages, and other wheeled vehicles were built and coppice oak proved a convenient source of timber for wheel spokes. Some demand was evident by the 1790s, when spokewood from the coppices of south Perthshire was sent to urban coachmakers (Robertson (1794) 96-7). By the 1820s spokewood was reckoned to be a significant part of coppice produce; by 1860 bark and spokewood together were the most valuable part of oak coppice, and they retained this position fifteen years later (Monteath (1824) 245, Brown (1861) 520-1, Gilchrist (1874) 125).

This market provided a large and consistent demand for timber in a compact form suitable for carriage. Timber as small as three inches (7.6 cm) in square side could be used, being 'blocked out' or cut into rough sections on the site; dimensions varied with requirements but the rough spokes were in general between twenty-two and thirty-four inches in length (56-86 cm), and three to four inches in breadth (7.6-10.1 cm). Blocked spokes were sold in 'long' hundreds of 120 or 'gangs' of 25 (Monteath
Transport was a relatively small problem in the disposal of spokewood. Coachmaking was concentrated in the larger burghs, among which Perth was a noted regional centre, but by the early nineteenth century cartwrights were working in most parts of the rural lowlands and southern Perthshire (Boaz (1814) 291); in preparing his evaluation of coppice yields Monteath made no allowance for the cartage of spokes, on the grounds that almost every district had a wright prepared to collect the timber from the wood at his own expense (Monteath (1824) 264). In the more remote parts of Perthshire and Argyllshire wheeled transport made a late appearance, but the compact nature of spokewood made it as convenient a form as any for sale to the markets of the south and fringe.

Like the establishment of the ironworks, the growth of demand for spokewood raised the value of timber above the level necessary to cover the costs of preparation and carriage of bark. Monteath's detailed estimate of the yield of coppice at the age of twenty-five years was based on the assumption that bark, spokewood, and brushwood could be sold; spokewood accounted for ninety per cent of the value of timber, which as a whole represented one third of the value per acre, a level comparable to Walker's earlier estimate of the relative value of charcoal. Preparation and carriage of the produce accounted for only twenty-one per cent of the total value of the produce of an acre (Monteath (1824) 262-4). Monteath's calculation
omitted a number of less consistent but more profitable uses of whole oak timber. In the early nineteenth century oak was sold as house timber and fence wood in the south Highlands while coopers and boatbuilders paid well for suitably shaped wood (Graham (1812) 212, Whyte & Macfarlan (1811) 155). These demands had developed from the older Highland economy, but others were more recent developments; urban cartwrights were willing to pay exceptionally high prices for complete young oak stems suitable for use as cart frames (Monteath (1824) 197-8).

As suggested above, coppice timber was suitable for the production of barrel staves; casks were required for butter and other commodities and there was a specialised demand for herring and salmon barrels in the fishing districts and in the Highland burghs. The construction of fishery barrels was regulated by parliament as early as the sixteenth century; an act of 1693 following an ordinance of the convention of Royal Burghs stipulated that salmon and herring barrels should be of certain dimensions and made of well-seasoned knapple or oak timber (APS V.2 (1814) 325, V.9 (1822) 260a, Warwick, ed. (1866-80) V.4, 153). Knapple was unmeasurable oak timber of consistent size; in the schedule of export levies set in 1661 one piece of knapple was equivalent in value to two staves (APS V.7 (1820) 251-2). Although such timber could be obtained from coppice barrel staves were generally imported; at the beginning of the eighteenth century knapple
and staves came from Norway, Hamburg, Bremen, and the Baltic (Spreull (1705) 4-5).

The series of acts governing the herring bounty system introduced in 1749 set similar standards of barrel construction, which continued long after bounties ceased in 1829 (Jenkins (1920) 114, Hodgson (1957) 55-6). Herring barrel staves were in general thirty-one inches (79 cm) long and on average four inches (10.1 cm) broad (Monteath (1824) 202-3); these dimensions are similar to those of spoke-wood but there is little evidence of the use of Scottish coppice oak as stave timber during the period. Imports continued to dominate the market after 1800, by which time the use of domestic oak for barrels destined for export was forbidden, presumably as a means of conserving native resources (Walker (1812) V.2, 268-9, Boaz (1814) 293, Monteath (1824) 198-9). The American colonies had become the major source of staves, which were commonly imported as deck cargo on vessels loaded with tobacco (Devine (1973) 56). The supply was however disrupted by the war of independence; the quantities obtained from North America fell markedly and remained well below the earlier level during the following few decades, and sharp increases were recorded in the prices of staves and barrels in Scotland (SR0 RH.2/4 (12) 3-4, RH.2/4 (24) 1-4, RH.2/4 (26) 1-5, RH.2/4 (34) 2-11, RH.2/4 (42) 3-9, OSAS V.10 (1794) 552). Restrictions on the nature of barrel timber were relaxed in the early nineteenth century, however, and the only timber
forbidden under the fishery act of 1815 was that of pine (Monteath (1824) 198-9, Thomson (1849) 206).

Thereafter domestic timber came into regular use, but birch was most generally employed, while alder and other small hardwoods were also cut (Monteath (1824) 199, Thomson, ed. (1864) 234); it is probable that in the ports imported oak was considerably cheaper than the domestic product, and that there were more profitable markets for the oak of inland coppice. Birch was first cut for herring barrels in the second decade of the century; in 1812 Walker thought that oak might be replaced in the future and in 1814 Boaz recorded the use of oak alone, but in 1819 Southey recorded extensive cutting after successful experiments with birch timber (Walker (1812) V.2, 268-9, Boaz (1814) 293, Herford, ed. (1929) 146-7). Not only established mixed bark coppice was used; MacCulloch complained of the irresponsible exploitation of tracts of birchwood which had previously been found of no commercial value, and Monteath noted that the increased value of birch and small hardwoods had led to the cutting of small plantations of these species previously used only as sources of fuelwood; the portability of cut staves made them an attractive commercial proposition even in the more remote areas (MacCulloch (1824) V.1, 438, Monteath (1824) 199-200).

Although only supplementary to imported supplies this use of birch remained the most important and profitable
until the end of the 1830s, and cutting was continued into the following decade (Blaikie (1829) 364-5, Anderson & Anderson (1834) 13, NSAS (1845) V.10 (Perth) 775). The profit margin appears in general to have been slight and by the end of the 1840s Norwegian timber dominated white herring cooperage, although domestic plantation thinnings, poor timber, and other Scottish material was used in the secondary red herring trade (MacCulloch (1824) V.1, 438, Thomson (1849) 95); twenty years later the market for domestic barrel timber was insignificant, and more profitable uses had been found for birch (Brown (1861) 209).

Cooperage also provided a demand for smaller coppice timber; regulations concerning the form of fishery barrel hoops were less stringent. In the early part of the eighteenth century both hoops and staves were largely imported; thus between 1715 and 1725 an Inverness merchant obtained staves from Hamburg, Danzig and Norway, and hoops in large quantities from London and Holland (Mackay, ed. (1915) 26-9, 47, 52). By the middle of the century domestic coppice timber was in use and coppice purchasers in some districts were allowed to cut black hoops before the axe; this term described the removal of suitable shoots of species other than oak from haggs or sections of mixed coppice in which the oak was too young for sale (SHO GD.220 Wm.32, Wb.3)); if consistently done this allowed the merchant an additional
profit and the proprietor had his woods thinned without charge. The operation had hazards which at times discouraged its use. Thus in 1761 the duke of Montrose refused to let a purchaser cut hoops through the woods of Menteith; he alleged that this subsidiary task would be left to the least skilled of the workforce and that the more valuable timber might be damaged (SHO GD.220 [Wm.35]). Nor was it always an efficient means of thinning; in cases where the oak itself was thus thinned merchants tended to cut not when thinning was most appropriate but when the best shoots were suitable for hoops, and the inferior growth was left as a source of bark (Whyte & Macfarlan (1811) 151). One alternative was to leave an area of barren timber exclusively for hoop production; the duke of Argyll considered doing this at Ardtornish in Morvern in 1789 (Cregeen, ed. (1964) 158, 165).

The value of hoops as a subsidiary source of coppice revenue declined in the early nineteenth century. By then it was more profitable in Dunbartonshire when thinning oak to peel the bark and dispose of the stripped thinnings as fuel (Whyte & Macfarlan (1811) 152-3); after the 1820s hoops were in general a very small part of coppice production. The best woods for hoops were hazel and the willows cut on a rotation of two or three years; such frequent cutting was incompatible with the longer rotation of oak coppice and few proprietors appear to have solved this problem by planting separate osier beds and hazel coppices
(Robertson (1799) 241, Walker (1812) V.2, 257). Imports supplied most of the demand; Walker noted that most willow used in Scotland for cooperage and other purposes was from the traditional sources in England and Holland, and although Boaz asserted that most hoops were of native willow or iron Monteath stated that the demand was met by Dutch and English wood (Walker (1812) V.2, 268-9, Boaz (1814) 293, Monteath (1824) 206).

When the demand for native hoops declined in the 1820s other uses were found for thin coppice shoots, and particularly thinnings. The textile industries and other users required increasing amounts of wicker and basketwork for storage (Boaz (1814) 292). In the accounts of the Montrose estates the sale of hoops was recorded as late as 1826 but from the following year until the end of the surviving account series in 1833 coppice thinnings were instead sold as basket rods and wattling; willow and hazel rods were also occasionally sold (SRO GD.220/6 (56) (1826-33)). Similar materials were still required near the end of the century, when thinnings of oak and other coppice species were sold as crate and hamper wood; birch and alder thinnings were in demand in Glasgow as wands and crate rods, and prunings for brooms (Gilchrist (1874) 128, Gilchrist (1876) 213). Other uses were found for large birch and alder earlier in the century; both were employed in the manufacture of shoe lasts, although American birch was most commonly used (Monteath (1824) 215-6).
textile trades used a number of species as bobbin wood; birch bobbins were manufactured at points in the Highlands where supplies remained plentiful (Brown (1861) 510-11). In the 1840s they were produced for the Dundee market at Camserney on the upper Tay, and a bobbin works at Salen on Loch Sunart used about 1,400 tons (1,422 t) of birch timber per annum (NSAS (1845) V.10 (Perth) 775, Somers (1848) 151).

The disposal of small coppice timber was facilitated by the appearance of estate sawmills. Whether operated by estate employees or leased to the purchasers of woodland, they allowed rapid and efficient rough-shaping and grading of material on or near the cutting site to suit diverse and dispersed markets. On the Montrose estates a sawmill was built about 1825; its effects are identifiable in the accounts of the following years, which became considerably more specific in identifying an increasing range of rough-shaped forms of timber (SHO GD.220/6 (56) (1826-33)). The advent of the circular saw in the early nineteenth century was especially significant. Such saws could be used to shape large timber but their cheapness, simplicity, and operating efficiency in relation to the conventional upright saw made them especially suitable to deal with coppice and small timber (Monteath (1824) 199-201, Singers (1829) 145). Monteath considered the introduction of the circular saw to be a major contribution to the success of birch stave cutting, and MacGulloch
thought it the one factor which allowed stave cutting to remain marginally profitable (Monteath (1824) 199, MacCulloch (1823) 265).

Despite the increased range of markets for the species of timber previously of little commercial value and the greater operating flexibility provided by the circular saw, a considerable residue of coppice brushwood and loppings could not be sold as timber. This residue, known in the early nineteenth century as 'tonwood', was chemically treated or sold as domestic or industrial fuel. Disposal of tonwood depended on the local range of available outlets; by 1810 much of the refuse of Dunbartonshire coppice could be sold to industrial users in the Glasgow district but peeled coppice oak was still a common fuel in parts of central Perthshire after 1840 (Whyte & Macfarlan (1811) 155, above, 3.5). In the more remote parts of the coppice counties spokewood and staves could not profitably be sold, and relatively large timber was of value only as firewood after rural timber demands had been satisfied.

Charcoal remained important in Argyllshire, but there was a change of emphasis in the early nineteenth century; the closure of Argyle Furnace on Loch Fyne about 1813 greatly reduced the demand for smelting charcoal in the southern part of the county (below, 10.6). An alternative was provided by the growth of the gunpowder industry, for
which charcoal was essential. In the earlier part of the century the small Scottish industry was concentrated in the Lothians but it later expanded to the Glasgow district; between 1835 and 1845 there was a remarkable expansion of the Glasgow industry into south Argyllshire (Boaz (1814) 314). At least five works were founded in that decade, three in Durnoon parish on the upper Clyde, one at the mouth of Loch Fyne, and another close to the site of Argyle Furnace (NSAS (1845) V.7 (Argyll), 366, 612, 692).

The requirements of gunpowder production differed from those of iron smelting; oak was found less suitable than alder, birch, hazel, willow and rowan (Monteath (1824) 249, Blaikie (1829) 362-7, Brown (1861) 518). There was therefore in some districts a considerable improvement in the status of the species formerly considered of minor importance. The Scottish industry followed that of England in showing a marked preference for alder in particular (Nisbet, ed. (1908) V.2, 117, Wilson (1963-4) 49); in south Argyllshire the relative value of alder increased greatly, although Norwegian sources were able to supply timber at lower prices than domestic merchants (NSAS (1845) V.7 (Argyll), 612). Charcoal made to less strict specifications was required for a number of other purposes apart from the continued iron smelting of north Argyllshire; it was used as domestic fuel, in foundry work, in the manufacture of paint and varnish and the polishing of metals,
and to purify alcohol (Singers (1829) 138-9). In some cases it was produced by traditional methods but it was also available as a by-product of another important use of tonwood.

Pyroligneous acid, a form of acetic acid used especially in certain parts of the linen and cotton industries, was prepared by distillation from wood by a method which left marketable residues of tar and charcoal; it was also used as a source of vinegar (Monteath (1824) 244). Acid production was firmly established by 1815 and seven works were in operation, all but two in the Glasgow district; two of these were in Dunbartonshire and by that time much of the small wood of the county was sold for this purpose (Boaz (1814) 308, Whyte & Macfarlan (1811) 155). As the century advanced increasing amounts of tonwood were used; the Glasgow district remained the centre of pyroligneous acid production but works were established in other textile districts before 1850 (Monteath (1824) 244-5, Blaikie (1829) 367). By 1845 two works in Falkirk were producing vinegar and acid for textile work, and a large textile company near Perth operated a plant from which charcoal was sold to the foundries and dyeworks of the city (NSAS (1845) V.8 (Stirling), 19, V.10 (Perth), 94-5). A works on Loch Awe was run by an established Dunbartonshire company for the Glasgow market (Whyte & Macfarlan (1811) 155, NSAS (1845) V.7 (Argyll), 374).
There were certain advantages in the sale of waste timber to this market; all species were accepted, although the refuse of oak cutting was preferred (Whyte & Macfarlan (1811) 155, NSAS (1845) V.8 (Dunbarton), 96). The powder works accepted the smallest material but required that it should all be stripped of bark; acid manufacturers were willing to take similar material without stripping (Brown (1861) 209). If extensive areas were being cut conversion to liquid on the site in portable boilers allowed a saving in transport costs; such a boiler was in action producing vinegar on the Montrose lands of Aberfoyle as early as 1821 (Monteath (1824) 244, Atkinson (1821) 19). It is not easy to assess the comparative value of the sale of tonwood for powder charcoal and acid production. The delivered price of a ton of distillation wood in 1811 was £1, and rose as high as £1-10s in the 1820s; in 1845 the plant at Balmaha near the large and regularly cut Montrose coppices paid only 7/0d per ton, but by the 1870s chemical works again paid between ten and twelve shillings per ton (Whyte & Macfarlan (1811) 155, Monteath (1824) 244, NSAS (1845) V.8 (Dunbarton), 96, Gilchrist (1874) 125). Less information is available about the price of charcoal wood, but in the 1860s the delivered price of a ton of birch for powder work was between £1-4s and £1-10s (Brown (1861) 209, Thomson, ed. (1864) 48).

It is probable that prices for coalwood were generally higher; the refuse had to be sorted and graded and the
expense of peeling unmarketable bark added to the vendor's costs. Together these uses of coppice refuse were important, playing a role in the coppice economy previously taken by timber as a whole; access to a powder-works or acid plant could have critical effects on the value of woodland. Thus Brown found that when demand for staves declined birch and alder were best sold to the powder-works. The price of oak bark had fallen and in the vicinity of these works birch was at times the more valuable species; the bark was less profitable but all except the smallest timber could be sold as powder coalwood (Brown (1861) 211).

The location of an area of coppice was of great importance. Many of the markets for whole coppice timber and industrial tonwood were coastal or urban; the produce of woods close to these markets was therefore in competition with imported supplies. The threat of competition from imports was less marked in the more remote inland districts, but commercial outlets for the produce of these districts were limited unless the produce was transported to the main markets at an expense which cancelled all or most of the possible profit. Relatively few commercial users of small coppice wood were based within the Highland zone, although amendment of the law relating to distilling allowed the legal operation of small stills, which required a substantial quantity of birch tonwood in the drying of barley (Blaikie (1829) 365-6). At any time each district had a unique pattern of commercial and domestic uses for coppice wood,
which determined the value of deciduous woodland and influenced the nature of coppice management.

For this reason it is much more difficult than in the case of bark to assess the value of coppice timber in different periods and at different points; there was no structure of stable delivered prices. It may be suggested as a general factor, however, that the value of timber, as determined by the proximity and size of markets, the nature of demand and the quality of overland transport, was critical to the operation of the coppice trade of any one district, although the market for bark remained the fundamental factor in the success of the trade as a whole. The value of timber was of greatest relative importance before 1790 and towards 1850 when bark prices again declined, but it was not insignificant in the intervening period of high bark prices. The boom in coppice management, which led to radical changes in the nature of both management and trade, appears to have arisen primarily from change in the relationship between the supply of oak bark and demand in the Scottish market. Nevertheless improvement in the value of timber during this period was an important factor in contributing to the expansion of coppicing and change in the nature of the trade. Even when coppice management was at its most profitable general level, districts favoured with good access to a range of markets for timber retained a distinct advantage.
8.5 The form of trade in coppice produce

Throughout the period the price of bark and the effectiveness of coppice management were affected, often adversely, by the mode of operation of the bark trade, in which direct agreements between proprietors and tanners were almost totally absent. In the majority of cases the whole operation, including the marshalling of labour and the marketing of both timber and bark, was carried out by independent individuals or partnerships most frequently described as undertakers, woodcutters, or merchants. Only at the end of the eighteenth century did regular differentiation between timber and bark merchants become evident; from that time bark merchants occasionally made the timber cut during a contract available to timber merchants, who had more knowledge of the increasingly complex forms of demand for timber (Whyte & Macfarlan (1811) 154-5). As in other aspects of coppice operation, there was a distinct difference between practice in Argyll and Perthshire.

It has already been noted that the produce of Argyllshire woodland was sent to Ireland about 1700; Irish merchants continued to be active in the county until at least 1730. Export of bark and timber to Ireland was evidently of considerable importance when Spreull wrote in 1705, and when the convention of Royal Burghs in 1707 approved a proposal that the export of bark should be banned to protect Scottish tanning Ireland was the only external market specifically
named (Spreull (1705) 3, Burns, ed. (1882) 63-4, Warwick, ed. (1866-80) V. 4, 430). At times the purchase and shipping of bark was arranged by local men, a factor which may to some extent conceal the importance of the Irish market. Thus in 1707 a tenant in Reshable (probably Kesipol on Loch Sunart) claimed before Inveraray Justiciary Court that an assault had prevented his acting as intermediary in a sale of bark to Ireland (Imrie, ed. (1969) 212).

In other cases, however, Irish merchants and tanners dealt directly with proprietors. In 1721 and 1722 Roger Murphey, a tanner from Eniskillen and later a partner in the Glenkinglass ironworks, purchased oak and other deciduous timber from the lairds of Lochneill, Inveresragan and Barcaldine in Lorn, Cameron of Lochiel, Macdonald of Glen-garry, and Macdonald of Morar; he also bought the bark of certain woods on Loch Awe originally sold to a local partnership by the earl of Breadalbane in 1716 (SRO SC.54/12/11 [b]). In 1723 Murphey and Captain Arthur Galbraith of Dublin bought pinewood in Glenorchy and deciduous timber on other parts of the Breadalbane lands; in 1724 a merchant from Drogheda, with Murphey and Galbraith acting as cautioners, bought the deciduous timber of Kinlochbeg above Loch Leven from Macdonald of Achtriochtan (SRO SC.54/12/11 [d], above, 5.7).

The Irish did not confine their attention to the west coast. In 1718 two partners from Donegal and Tyrone leased
woods on Loch Lomond and in Aberfoyle parish from the
duke of Montrose with the intention of establishing an
ironworks (SRO GD.220 [Wm.11], below, 10.5). Nor did the
Irish merchants have a monopoly of the produce of Argyll-
shire; in the period before 1730 timber and bark was
also bought by Glasgow craftsmen and partnerships including
local proprietors and merchants (SRO SC.54/12/7 [c], SC.54/
12/9 [b]). The presence of an Irish interest ensured,
however, that there were external influences on coppice
operation in Argyllshire in a period when trade in coppice
produce in other parts of the southern Highland coppice
areas remained the province of small local merchants. As
shall be seen later, the ironworks founded in the middle
of the century had a role which ensured that the coppice
trade in Argyllshire remained open to external influences
and distinct from that of other parts of the Highlands
(below, 11.4).

In most districts where there was a regular trade in
coppice produce operations were localised and merchants
cut woods largely within a few parishes familiar to them.
Thus the merchants interested in the Montrose woods of
Menteith and Kincardine in Perthshire almost all lived
within a few miles of the woods in question (Fig. 9.11).
Many merchants were tenant farmers although some, as early
as 1708, used the profits of trade to become small prop-
rietors (EUL DC.I.37 1/3, 11-12). For many of them trade
in bark and timber was a supplementary activity, and in
some cases evidently little more than an occasional speculation founded on limited experience and resources. In such circumstances failure to complete contracts was not uncommon; two successive contracts for the cutting of the Wood of Kincardine over a period of twenty-four or more years were abandoned between 1729 and 1736 (GD.220 [Wk.6a, Wk.9, Wk.10]). The highest bidder at an auction was not necessarily the most reliable; inexperienced part-time merchants might pay unduly high prices for coppice or lack the capital necessary to cover any difficulties encountered in the first few years of dealing with tanners. Proprietors at times took precautions against the failure of purchasers which may in fact have precipitated the collapse which they were intended to counteract. Thus in some cases purchasers were required to deposit cash as security, and in other cases the annual instalments of the purchase price were higher in the first few years of a contract (SR0 GD.220 [Wm.11, Wm.17]).

The brevity of wood contracts was a fundamental obstacle to stable operations in the coppice trade. Contracts of twenty years or more provided merchants with secure incomes, which in the event of death could be assigned to their sons; such contracts also allowed merchants to establish efficient arrangements for labour and carriage and to make long-term commitments in marketing (SR0 GD.220 [Wb.3]). In the seventeenth and eighteenth centuries, however, contracts were generally for periods of no more
than seven or eight years; this was unavoidable in the case of small woods but even the owners of extensive coppices usually favoured short contracts. No more than eight of the twenty-four divisions of the Menteith woods were commonly sold under one contract (below, 9.4).

Short contracts offered limited opportunities for efficient organisation; even merchants able to secure a continuous series of contracts found it necessary to make new arrangements for labour, carriage, and marketing at frequent intervals, and when competition was brisk there was no guarantee of continuous operation (Monteath (1824) 370).

The unreliability of bark merchants, which was in part due to the prevalence of short contracts, appears to have discouraged the adoption of long-term agreements. It has already been noted that in some cases more favourable terms were granted to merchants who had proved trustworthy, but this was not generally accompanied by the extension of contracts to cover a full rotation (SRO GD.220 [Wm.20]).

The greatest security offered to a merchant was generally preference after successful completion of a contract; thus Andrew Carrick, a tenant farmer, bought a cutting of Kincardine wood by auction in 1736 and continued work there under a succession of contracts until 1765, when the wood was sold for seven years to his son Robert (SRO GD.220/6 (50) (K1759, 1764-6), [Wk.11, Wk.12, Wk.13, Wk.14] ).

Until the end of the eighteenth century the bargaining power of bark merchants remained limited. The tanning
trade was largely controlled by a small number of burgesses and most burghs had a body of tanners working in close proximity to each other. They had a common interest in keeping bark prices at a low level, and as already noted appear to have been successful in achieving this (above, 8.3); they themselves were at times subject to attempts by their customers to force down the price of finished leather (RPCS Ser. 2 V.1 (1899) 238). Bark merchants clearly had an interest in lowering the price of coppice and raising the price of bark, but they had no craft organisation and no means of forming collective policy or working in cooperation. The part-time nature of the trade was to some extent responsible for this; when the market was favourable the regular bark merchants of a district were forced to compete with casual woodcutters who returned to agriculture and other regular occupations when prices declined. The localised nature of the trade ensured that although competition among merchants might be intense, most were obliged to deal with the tanners of the nearest market towns; few had the knowledge and resources to take advantage of regional variations in the market price of bark. When the supply of domestic bark exceeded demand proprietors too were in a weak position. It was not impossible for the cutting of a single large wood to satisfy a regional market, and at times cutting was deliberately delayed to avoid creating a temporary glut (Monteath (1824) 115, Anderson (1967) V.1, 448-9).
The persistence of short contracts prevented consolidation of the trade, and made it exceptionally difficult for an individual to operate on a large scale or dominate a regional supply. In a highly competitive trade merchants were eager to obtain contracts which would allow them to maintain a supply to their established customers (SHO E.777/50/1); with the security of a long-term contract a merchant could negotiate agreements to supply bark regularly to individual tanneries. Long contracts were seen as a means by which pressure could be exerted on the tanners; in a situation where the amount of bark accessible economically to a given market was limited the possessor of a twenty-four year cutting of extensive woods controlled considerable resources, and could affect the local supply by stockpiling or sending bark to other districts (SHO GD.220 [Wb.3]). Under a system of short contracts, however, merchants had no secure base for such operations, and even the most successful appear to have found a second means of support necessary to survive periods of inactivity.

While there was a steady demand for bark and a supply at least sufficient to satisfy it, casual dealers were active and the tanners were in a position to keep prices low by taking advantage of increased competition within the bark trade. Neither merchants nor proprietors were able to act collectively, and few were in a strong enough position individually to raise their prices without the risk of having their woods ignored or being undercut by their
rivals. When the market for bark was depressed prices fell and many merchants returned to other occupations; thus when prices were low in 1743 a roup of the Menteith woods attracted only one merchant, who attempted unsuccess-essfully to dictate his own terms of purchase (SRO GD.220 [Wm.24]).

Conditions were therefore appropriate for the control of the market by tanners, until demand outstripped domestic production without an alternative source being immediately available. The critical point when domestic supplies proved inadequate appears to have been reached near the end of the eighteenth century; the advantage passed to the proprietors, who were able, as the tanners had previously been, to exploit the competitive nature of the bark trade. The state of affairs at this time was recorded in 1793 by the minister of Clunie parish in Perthshire, who observed that too many cutters, many of them part-time merchants of doubtful competence, were in competition; the proprietors were driving harder bargains and seemed likely to start direct dealing with the tanners (OSAS V.9 (1793) 241). There is, however, no evidence that direct dealing was widely adopted; a more general and significant consequence of the rise in prices was the cancellation of any tendency towards the use of long contracts.

Purchase prices had previously been fixed sums generally paid in instalments, based on the value of coppice produce when the agreement was made. Such a system was
convenient if prices were relatively stable but clearly disadvantageous to proprietors during periods of rising prices; if contracts of the customary length had been retained it would have been necessary to calculate the price of each year's cutting independently. Proprietors instead resorted to the use of annual roups of single haggs or sections, at which they could expect to benefit from competitive bidding and obtain the highest price locally available in a given year (Whyte & Macfarlan (1811) 153-4). Even on the Montrose lands, where contracts for a full rotation were employed after 1750, each annual cutting was now independently auctioned (below, 9.4).

Merchants who previously had been able to obtain some security by entering contracts for seven or eight years could no longer expect to cut on the same estate in two successive years, and might visit several auctions in one year without success (Monteath (1824) 370-1). There was less opportunity than before for the efficient organisation of labour, transport, and marketing, and the brevity of contracts was an additional attraction to those who treated the bark trade as an additional venture. In this period the trade became more limited in scope; as already indicated, coppice timber was increasingly marketed by specialised timber dealers.

The bark trade may have become more stable and less crowded as the nineteenth century advanced but annual roups
and short contracts remained the rule; when it became evident that the decline in prices after 1815 was a continuing trend long contracts were as unattractive to merchants as they previously had been to proprietors. Extended contracts therefore remained uncommon through the whole period, and this had effects on the management of coppice as well as the organisation of the bark trade.

Long contracts were thought to be effective in preventing deliberate abuse and negligence. It was not unknown for merchants to exploit their privileges under contract, as was claimed tended to occur in the case of hoop cutting (above, 8.4). It was also possible that the labour force hastily assembled by a merchant to deal with a short-term contract might prove inefficient and unsatisfactory. Under short contracts merchants had little incentive to cooperate in management and proprietors had little time to recognise and check malpractice.

The purchaser of a full rotation, however, had an interest both in maintaining the quality of coppice and improving the value of the sections awaiting cutting; he was not under pressure to recoup his investment in the short term, and was able to assemble, train, and retain a skilled labour force (Monteath (1824) 370-1). Long contracts permitted proprietors to sell woodland of varied quality under a single contract, whereas short contracts and annual roups made it less easy to dispose of sections of poor or scattered wood. A merchant petitioned the Montrose
commissioners in 1757 claiming that a twenty-year contract would be an advantage to both parties. He himself would be able to operate more efficiently and make profitable long-term arrangements with certain customers; he could therefore pay more, and the constant employment of skilled men would permit better attention to the woods (SRO GD.220 [No.3]). Monteath stated a similar case in 1824 and optimistically anticipated the time when coppice would regularly be leased for periods of twenty-four years, with advantages comparable to those of long farm leases (Monteath (1824) 370-1).

Although the rarity of long leases prevents adequate comparison of the effects of the different systems, it is likely that the regular use of contracts or leases covering full rotations would have had significant effects on the quality of woodland, and indirect benefits in providing a more satisfactory basis for the bark trade. As in other cases, however, proprietors preferred an assured short-term profit to the less tangible long-term benefits of careful management, and the forces which acted as incentives to the improvement of woodland also encouraged exploitative behaviour. Without a significant rise in the price of bark less attention would have been paid to the management of coppice after 1790, but the same substantial price increase led to the adoption of annual auctions and other forms of management which directly and indirectly must have cancelled a considerable part of the money and effort.
expended on improvement.

8.6 The structure of coppice in relation to trade

As already noted, the viability of a felling operation in pinewood depended to a large extent on the pre-existing structure of the wood (above, 5.6). Exploitation of deciduous wood differed in that coppice management could be applied with success to most forms of woodland, and coppicing itself could have significant effects on woodland structure within a relatively short term. In a coppice regime the structure of woodland became predominantly youthful in character; repeated cutting at short intervals prevented the accumulation of measurable timber. In compensation, however, the relative brevity of coppice rotations allowed some flexibility in management and adjustment to follow change in the form of demand; a time lag between the initial decision and its full implementation was inevitable but the nature of an area of coppice could be radically changed within the twenty-four years or less of a rotation. As already noted coppice could be extended by planting and enclosure of scrub and the species composition could be altered; division into annual cuttings allowed the costs of improvement to be distributed over the rotation as a whole (above, 7.5).

The management of coppice principally as a source of oak tanbark limited the flexibility of the system to some extent and had significant effects on the structure of
coppice wood. The primary effect was in determining the interval at which a coppice was cut over; although large timber is more efficiently stripped than coppice wood the proportional tannin content of oak bark declines markedly as age increases (Brown (1861) 538, Howes (1953) 7, 84). In Scotland it was believed that the tannin yield of bark about twenty-four years old was greatest, and the bark of mature trees and small coppice thinnings was usually sold at lower prices (Monteath (1824) 118-20). Bark stripping is also a highly seasonal activity, most easily carried out immediately after felling in a short period after the rise of the sap in spring; if timber is felled in other seasons or allowed to lie for a few days before stripping, force will be required to detach bark and the resulting damage and discoloration may reduce the market price (Brown (1861) 538, Howes (1953) 82-3). The Scottish stripping season generally lasted for no more than ten or eleven weeks; on the Montrose lands oak was cut between May 1 and July 1 in the early eighteenth century, but the season as defined by contracts was gradually extended to July 10 or 15 (SHO GD.220 [Wm.13, Wm.17, Wm.32, Wk.14]). In the early nineteenth century the season in most areas extended from early May to July 15; although it was desirable that stripping should finish before the end of June this was not always possible if large areas were to be cut (Monteath (1824) 140-1).

Oak timber is better in quality if cut in winter but
this is not possible if bark is given priority. Attempts to adapt to seasonal changes by stripping standing timber in summer and felling it in the following winter appear to have been unsuccessful; the growth of the bark trade in Britain permanently reduced the traditional dominance of felling in winter, when the low level of farm activity released labour for forestry (Anderson, ed. (1959) 13, Nisbet (1900) 121-4, Hiley (1954) 114). Bark production was labour-intensive; the brevity of the season and the vulnerability of stripped bark to weather damage prevented the use of a small workforce to carry out the operations in sequence, and it was necessary to employ separate teams simultaneously in cutting, trimming, stripping and drying bark. Most operations required some skill and experience, and the assembly of a competent workforce during a busy part of the farming year was a considerable problem; in some but not all districts female labour could be recruited in the towns (Gilchrist (1874) 122-5, Monteath (1824) 148-9, Brown (1861) 529, Whyte & Macfarlan (1811) 154-5).

In mixed coppice the felling and preparation of barren timber among the oak wasted time and labour during this short season, but cutting of such timber after the oak damaged the new growth of autumn and was prohibited in many contracts. One solution was the cutting of barren timber in March and April and its removal with the felled oak during the summer (Monteath (1824) 145-9, Brown (1861) 520). In Argyllshire the ironworks required a steady supply of
charcoal and areas in which barren timber predominated were cut over between November and the beginning of May, under the name of 'winter timber' (below, 11.5). Such operations were most effective if areas dominated by oak were isolated from the barren timber and separately enclosed; this was immediately possible in some woods and in others the concentration of oak could be augmented by planting; the barren timber could be enclosed as commercial coppice or left open as grazing or shelter.

Segregation of this type was not uncommon in the late eighteenth and early nineteenth centuries, and in many cases the barren timber was excluded from the area of woodland under efficient management (above, 7.6). It may be said that in general the structure of semi-natural wood had a limited effect on the form and effectiveness of subsequent coppicing; several aspects of coppice management and trade encouraged modification of the composition of woodland, which could be effected without great difficulty in a relatively short time. The most important effect of the demand for oak bark was artificial species segregation and selective protection of oak; profitable commercial markets for barren timber appear to have come too late to have a substantial effect on this pattern.

8.7 Accessibility

Problems of physical accessibility were rather smaller than in the case of pine timber. Oak was most prominent
as a native species in parts of the south and west Highlands relatively close to the lowland markets and coastal shipping points. The short period required for the consolidation or enlargement of coppice allowed some freedom of choice in the location of managed woodland at the most accessible point within an estate. In addition, coppice produce was generally compact in nature and more valuable per unit of volume than pine timber (above, 5.6); bark and the more valuable forms of timber could be moved by packhorse where wheeled transport was not available. Despite this series of advantages, the problems of economic and physical accessibility were not entirely insignificant, as is indicated by the customary arrangements for the carriage of bark.

The service of carriage was a customary condition of tenancy, and such services proved of value in the transport of bark. There is evidence of their use in the seventeenth century; proprietors obliged themselves in bark contracts to supply carriage horses in numbers greater than they personally can have possessed, or to carry the bark at their own expense; this second obligation was later undertaken in cases where bark carriages were definitely employed (SRO GD.220 [Wk.1], E.783/76/3, E.783/60/35(1), Innes, ed. (1848) 294-5). In the following century it was commonly stated that a specific number of carriages or horses, or those pertaining to certain lands, should be made available (SRO GD.220, [Wm.11], E.777/50/1).
Carriages were subject to certain restrictions. They were usually available only during the oak cutting season and the following three or four weeks, and in some cases limits were set on the size of the load (SHO E.777/50/1, GD.220 [Wm.13, Wm.7]). The lengths were also generally prescribed, varying from twelve miles (19 km) in the case of Kincardine wood to twenty (32 km) or more from the regality of Atholl (SHO GD.220 [Wk.3], EUL. Dc.I.37 1/3, 12). Not all were to the most convenient points; in 1698 the bark of Ledlewan wood near Loch Lomond was to be taken about thirty miles (48 km) to Linlithgow or Bo'ness, although the wood lay only twelve miles from Glasgow (SHO GD.220, [Wx.1]). In a few cases the longer carriages may have been divided into stages. Thus under governmental administration the bark of the Perth estate woods in Comrie parish was carried over thirty miles to Perth, Kinross, and Alloa; services were required not only from Perth estate tenants in Comrie parish but from those in parishes nearer these destinations, and each journey may have been split into two carriages of about fifteen miles (SHO E.777/50/1).

Carriages were disliked by those who advocated agricultural improvement; the author of the proposals for the regality of Atholl in 1708 noted that the long carriage disrupted the pattern of farm work and exhausted the tenants' horses (EUL Dc.I.37, 1/3, 13). Rather later Mackintosh of Borlum proposed that all carriages except those
of fuel should be abolished (Mackintosh (1729) 2-3).

In some cases tenants were required to make themselves and their animals available on a few days notice (SHO ED. 220 [Wk.1]); carriages were therefore unpopular and any extension of their use beyond the accepted level was deeply resented (Allardyce, ed. (1888) V.2, 301n). Each tenant of a half merkland in Rannoch was required annually to perform a carriage of deals from the sawmill to Perth, a distance of forty-five miles (72 km) (SHO E. 783/1/9). When the factor required additional short carriages of oak bark in 1758 and 1759, one former tenant submitted a petition to the commissioners complaining of this as an imposition (SHO E. 783/60/35 (1)).

The factor's defence indicates the value of carriages to the bark trade at the time. He claimed that tenants were liable to perform such services throughout the Highlands and Scotland as a whole, and that the eight-mile (13 km) carriage in question was short in comparison to some of eighteen or twenty miles (29-32 km). In many districts there was no other means of transport and in the absence of carriages woods could be sold only with difficulty (SHO E. 783/60/35 (3)). Carriages did not represent free transport; they had a cash value indicated by their conversion to money payment in some rentals, which proprietors probably incorporated into the purchase price of woods. Without carriages, however, it was necessary for the purchaser himself to recruit a body of men and pack animals for the
bark season at short notice, and to face the additional costs of feeding and accommodating any labour imported from other districts. The number of carriages available was not always sufficient. In 1759 the purchaser of the woods of Strath Gartney found it necessary to let a farm there to support additional horses and labourers; in 1762 he complained that the carriages given to him by the annexed estate commissioners met only ten per cent of his needs (SRO E.721/4, 164, E.721/6, 208).

Although previously in general use bark carriages declined greatly in importance in the later part of the eighteenth century; several related factors may have contributed to this. When agricultural methods and forms of tenancy were reorganised, services were seen as anachronistic; during the gradual reform of Scottish agriculture some disappeared and others were replaced by additional rents. The increased use of mineral coal as a fuel in the last decade of the century provided a new use for such carriages as were retained; thus by 1795 the sole services demanded in the south Perthshire parish of Fowlis Wester were carriages of coal and bark, and only coal carriages were by then required on the Montrose lands (SRO GD.220/6/80, 95-7, 05A5 V.15 (1795) 605). As some of those liable to them regarded carriages as a gratuitous burden, they were not always satisfactorily performed and were a possible cause of unrest. One solution to this problem was the calculation of a cash value as an alternative to
service or as a replacement.

This was done relatively early on parts of the Montrose lands; after 1735 purchasers of the Menteith woods were not offered carriages and for some time the cash equivalents figured in the estate accounts as a source of income, although later incorporated in rents as a whole (SRO GD.220/6 (48), GD.220/6 (49) (M1741-53) [Wm.13, Wm.17]). Bark carriages were not fully superseded on the estate for some time; a contract of 1752 again allowed the purchaser to make use of carriages, on payment of the cash value to the tenants involved (SRO GD.220 [Wm.32]). Another factor contributing to the decline of carriages was the reduced relative importance of transport costs in the bark trade. In cost estimates made for the Menteith woods in 1743 manufacturing and transport to Stirling and other markets a comparable distance from the woods accounted for fifteen and twenty-two per cent respectively of the average market price of bark; in Menteith's estimate of 1824 manufacturing accounted for twenty per cent and carriage for slightly less than seven (SRO GD.220 [Wm.24], Monteath (1824) 262-3). These assessments are not precisely comparable; the earlier refers to a specific case with a relatively long carriage and the later is a generalised average. At the 1824 delivered price of £14 per ton, however, freight costs would have to be about £3-2s per ton to be equivalent to the 1743 level, and there is no evidence that they were generally higher than Monteath's estimated average of
Reduction in the relative importance of transport costs may be associated with an absolute reduction in freight rates as facilities for overland haulage improved; improved transport facilities were recognised as a great aid to coppice operation and Monteath observed that with the advent of reliable cart roads bark could be carried forty miles (64 km) to a market or shipping point without prohibitive rises in freight costs (Monteath (1824) 113). Even if freight rates remained stable or rose slightly, it is probable that there was a greater increase in the cost of stripping and the price of bark, reducing the significance of carriage costs; the price of bark rose sharply and manufacturing costs are also known to have risen (Whyte & Macfarlan (1811) 155). In such circumstances the value of carriages to the purchasers of woodland may have been insufficient to outweigh the advantage to the proprietor of abandoning them or applying them to other purposes. It has already been noted that equation of the value of timber with operating costs became inappropriate at the end of the eighteenth century (above, 8.4); the abandonment of bark carriages appears to be another aspect of a general change in the cost structure of coppice operation which led to this.

Cost differentials survived; better transport and higher prices allowed profitable operation farther from market areas, but coppice cutting in certain parts of the
south and west Highlands remained most profitable and least sensitive to market depressions and cost increases. Coppice management was practised to some extent through the whole Highland area but the initial advantage of the established southern districts was augmented by the late development of wagon roads in the Highland interior and the absence of local commercial markets for timber in the interior to support the additional cost of carrying bark to southern or coastal markets. The greatest response to higher bark prices was in districts where coppice had previously been feasible in less favourable conditions; operations remained marginal in the more remote areas and formal coppice management was not adopted widely in response to increased demand in the lowland markets. Thus in the early nineteenth century it was said that management remained rudimentary throughout Inverness-shire, and that only two proprietors, both with coastal properties on the Argyllshire boundary, enclosed their oak coppice (Robertson (1808) 208-10).

It may be noted that bark carriages were not customarily granted in Argyllshire. The land area of the county was penetrated by navigable water, and few coppices were more than five miles (8.0 km) from the ocean coast, a sea loch, or a freshwater loch with good access to the coast. There were few local markets for bark except for the tanning of fishing tackle, and most of the bark was sent southward from shipping points near the woods; after 1750 much
of the bark was handled by the iron companies, which main-
tained their own stocks of packhorses (below, 11.5, 11.6). The short landward carriage to the shore was a small part of the general cost of carriage; Monteath estimated that landward movement of a ton of bark cost on average £1-0s, but noted that bark could be carried to the shore from certain farms on Loch Fyne for only 2/0d per ton (Monteath (1824) 262-3, Monteath (1827) 16). Coppice management in Argyllshire was distinctive in a number of ways and the absence of bark carriages may simply reflect established local practice rather than a lack of demand, but it is probable that they were never found important in a county where long overland hauls were rare.

It may finally be noted that coppice operations were affected to a smaller extent by the social and political difficulties encountered in the pine trade. Some contracts, especially before the middle of the eighteenth century, promised protection against theft from the woods, or compensation for theft of the merchant's horses and equipment (SHO GD.220 [Wk.3], SC.54/12/10 [d]). The cutting of coppice, however, seems seldom to have aroused enmity among neighbouring proprietors or hostility to strangers; disagreements over stands of pine were more frequent and seem to have arisen in part from mistaken ideas about their commercial value.

Most of the valuable coppice of the Highlands was in
the south and on the margins. These areas were more open to exterior influences and the administration of centralised justice than the interior or the north; they were also less affected by unrest than other parts of the Highlands. Cutting of the Montrose woods in southwest Perthshire and Stirlingshire continued without apparent interruption during the rebellions of 1715 and 1745 (SRO GD.220/6 (47) 129-64, GD.220/6 (49) (M1745-7)). Although the turbulence of the northern and central Highlands may have contributed to the limited expansion of coppice in these areas before 1750, coppice remained of minor importance there throughout the period in which management was most fully developed elsewhere.

8.8 The effects of trade in coppice produce

The relationship between coppice management and trade was complex. The management methods applied to Highland coppice were designed basically for the production of oak tanbark. Semi-natural oakwood was consequently encouraged and augmented by planting; both the cutting interval and the season of felling were determined by the interests of bark production. Trees of other deciduous species were neglected or excluded from management but often exploited when it was profitable to do so. The form of management was therefore determined by the nature of the product required, but the interests of management and market were not identical. The management methods likely to be most
beneficial in the long term were not invariably those which yielded an immediate profit, and there was a continual conflict between the interests of conservation and long-term planning and those of short-term gain.

It cannot be said that proprietors always supported the interests of management against the demands made by bark merchants. The bark trade was weak and fragmented and the merchants could exert only a limited amount of pressure on unwilling proprietors; it is evident that in many cases the proprietors themselves gave priority to immediate gain. As has already been observed, one frequent result of such a choice was tolerance of practices on the part of bark merchants which were directly or indirectly harmful to the coppice. There is no evidence to suggest, however, that the forms of cutting employed by merchants were worse than those employed in casual cutting for domestic use, and in some districts the standard of cutting appears to have been high enough to permit improvement of the quality of woodland.

Coppice cutting as practised in Scotland was therefore not in all cases the most effective means of conserving semi-natural woodland, but it may be said in conclusion that the effects of coppice cutting were very similar to those of different forms of management. Woodland was preserved or improved by good coppice cutting; the deleterious effects of poor cutting lay primarily in permitting the action of factors which would have been no less harmful
Figure 8.1. Major coppice production zones in Scotland, c.1800.
and probably more damaging in the absence of commercial use (above, 7.7).

The relationship between management and market was also expressed in a less direct way, in the relationship between the location of markets and the form of coppice development in different districts. A tendency toward regional differentiation is apparent during the evolution of coppicing in Scotland, and especially after 1800. It is possible to distinguish four main producing areas in the south and west Highlands, and these are shown on Figure 8.1; the standard of management was relatively high in all of them but each had a characteristic mode of marketing which was distinctive in itself and had influence on the management of coppice (Fig. 8.1).

The first zone included the coppice areas of Argyllshire, which were characterised by the continued importance of external markets for bark and internal commercial demand for coppice timber. Glasgow and the upper Clyde were the main destinations for Argyllshire bark, although export to Ireland was important in the early eighteenth century and continued on a small scale later in the period. The two major ironworks provided a regular demand for much of the coppice timber available; both dealt directly with proprietors and maintained their own stocks of workhorses, and one at least was active in the bark trade. This may explain in part the rarity of bark carriages and the absence of small merchants from the Argyllshire trade (Fig. 8.1).
The second main region was the area of coppice accessible to the bark and timber markets of the Glasgow district, including Dunbartonshire and west Stirlingshire; southern Argyllshire was also directly affected by the demands of the Glasgow market after the closure of Argyle Furnace in the early nineteenth century. Although there is no direct evidence contemporary evaluations indicate that this was the most profitable coppice district after the late eighteenth century. It had access to a major bark market and varied markets for the better coppice wood; most of the principal industrial users of tonwood were also located around Glasgow or within the zone itself. Several trends in the later phase of the coppice trade appear to have developed here initially or exclusively. (Fig. 8.1).

The third zone included the parts of Stirlingshire and southwest Perthshire for which Stirling was the most accessible major market town. Bark prices at Stirling appear to have been comparable to those of Glasgow and bark could be shipped to Edinburgh and the lower Forth; Falkirk had minor industrial markets for tonwood. Access to markets seem to have been limited, however, and the opening of small local tanneries in the late eighteenth century may indicate that it was found cheaper to process hides near the source of bark than to carry bark relatively short distances overland. Markets for timber appear to have remained limited; spokewood could be sold but large
quantities of the poorer material were sold as domestic fuel and for rural use (Fig. 8.1).

The fourth and final zone included the eastern part of the Highland margin in Perthshire, extending northward along the valleys of the Tay river system. Bark was sold to Perth, Dundee, and the smaller burghs of the district, but the regional price appears to have been relatively low. There were industrial demands for coppice timber, especially in the textile trades of the Perth and Dundee districts, but they appear to have had limited effects; toward the middle of the nineteenth century coppice wood was still commonly sold as domestic fuel and for other local purposes. Both coppice zones of Perthshire seem to have been unable to take full advantage of the value of timber when bark prices fell (Fig. 8.1.).

This pattern of regional differentiation appears to have been created more by markets for timber than those for bark. The form of trade in bark itself is not sufficient to account for the distinction between the consolidated and stable system of Argyllshire and the flexible operations of the zone nearest to Glasgow; coppicing was recorded early in both regions of Perthshire but they later showed a less prompt response to favourable circumstances than the Glasgow region. Ease of marketing timber may account for part of the regional variation. Coppice timber was compact in form but low in value per unit weight relative to bark; markets for timber were therefore more
localised, and districts without adequate internal demands for timber appear to have been at a disadvantage in the coppice trade in general. Coppice management and trade in the Highlands was founded on the production of bark and any change in the market was of great significance, but the profitability of the bark trade to proprietors and merchants was small enough throughout the period to make the disposal of timber critical in coppice operations.

8.9 Summary

Commercial tanbark coppice expanded in the south Highlands and was the major form of commercial use of Highland deciduous wood in the eighteenth century and the first half of the nineteenth. Prices rose irregularly until about 1735, then remained relatively steady until about 1790. At that time the domestic supply appears to have become inadequate; prices rose irregularly but steeply and trebled by 1813. After that date imports became significant and domestic prices declined slowly.

In Argyllshire charcoal for iron smelting was required, especially after 1750; elsewhere oak coppice wood could be sold as spokewood and there was a succession of uses for the small timber of other species and coppice refuse. The relative and absolute value of timber rose after 1800; the sale of timber was critical to profitability in the bark trade, and higher timber prices later compensated to some extent for reduced bark prices.
The bark trade was fragmented and localised; the demand for coppice produce developed so as to prevent improvement. After 1790 merchants were compelled to accept annual sales, which may have encouraged malpractice in cutting. The importance of bark in coppice led to the creation of segregated coppice with selected protection of oak. Transport costs were not negligible and bark carriages were employed to offset these before 1800; costs were high enough to prevent rapid expansion of coppice in the more remote areas when prices improved.

Compromise between management principles and commercial requirements was necessary; management standards were to some extent lowered but it is improbable that cutting as coppice was more damaging to wood than the casual exploitation common in the Highlands. In the main coppice region where management was most adequate distinct zones became evident; these appear to have been defined by markets for timber rather than bark.
CHAPTER NINE

COMMERCIAL USE OF THE MONTROSE COPPICES

IN PERTHSHIRE, 1650-1835

9.1 Introduction

The Montrose woods were of substantial importance in the coppice economy of Scotland. In the middle of the eighteenth century the second duke was thought to be the largest holder of oak coppice in western Scotland; in 1812 Graham believed that the third duke was perhaps the largest individual possessor of wood of this type in Scotland as a whole (SRO GD.220 [Wb.3], Graham (1812) 213). The Montrose lands were not extensive in comparison to estates like those of Breadalbane and Atholl. In the eighteenth century they consisted largely of the adjacent parishes of Buchanan and Aberfoyle, in Stirlingshire and Perthshire respectively, which together amounted to slightly more than 100 square miles (259 sq.km); the area of Perthshire as a whole is almost 2,500 square miles (6,475 sq.km). Most of the coppice was concentrated in the lower parts of these two parishes; in the 1750s the Buchanan and Aberfoyle woods accounted for sixty-three per cent of the average annual income from the estate woods. An additional eighteen per cent was provided by the compact and isolated wood
of Kincardine in south central Perthshire, and the remain-
ing nineteen per cent was distributed among three similar
but smaller woods in west Stirlingshire (SRO GD.220/6 (70)
231, Fig.9.1). Attention shall here be concentrated on
the woods in Perthshire, which accounted for slightly more
than half of the value of the estate woods at that time;
the history and morphology of the Buchanan woods has al-
ready been examined by Tittensor and Steele (Tittensor
561-82).

The Wood of Kincardine lies immediately south of the
village of Auchterarder on the south side of Strathearn,
in the gap leading to Strathallan (above, Fig.9.1). Al-
though the complex igneous mass of the Ochil Hills is imme-
diately to the south, the site is simple in geological terms;
the underlying rocks are homogeneous lower Devonian (Old
Red Sandstone) sedimentary strata (IGS (1969m)). As indi-
cated by Figure 9.2, the wood itself is relatively small,
being less than one square mile (2.6 sq.km) in area; it is
situated on the junction of the small Lochy Burn with the
Ruthven Water, a minor tributary of the Earn. The Broad
Wood fills the approximately triangular space between the
two watercourses, falling from 400 feet (122 m) in the
southwest to 200 feet (61 m) in the northeast. The wood
of Kincardine Glen lies in the deep but narrow valley of
the Ruthven, which continues for about a mile (1.6 km)
southwest of the southern extremity of the Broad Wood
Figure 9.2. The site of the Wood of Kincardine.
Figure 9.3. The site of the Menteith woods.
Kincardine Wood appears to have consisted predominantly of oak in the eighteenth century but contained other deciduous species; birch, elm, hazel, willow and alder were present in the eighteenth century and in the middle of the nineteenth century oaks were still associated with birch and hazel (SRO GD220 [Wk.14, Wk.15], NSAS (1845) V.10 (Perth), 298).

The earldom of Menteith, which included the woods of Aberfoyle, consisted of three baronies, those of Aberfoyle, Port of Menteith and Drummond, the last lying in the Stirlingshire parish of Drymen (SRO GD220/6 (68)). There are significant differences between the landforms of the northwestern and south-eastern parts of the earldom, which may to some extent be explained in geological terms. The Highland Boundary fault runs in a northeast-southwest direction through the site of Aberfoyle village; most of the parish of Aberfoyle lies to the northwest of the fault, the rocks being Dalriadian metamorphics characteristic of the south Highlands (Johnson (1965) 132-4). Sedimentary rocks lie to the south and east of the fault; a wedge of Oligocene strata runs immediately adjacent to the fault but sandstones of the lower Devonian (Old Red Sandstone) are elsewhere dominant (George (1965) 26-7, Walton (1965) 168-9).

As indicated by Figure 9.3, the metamorphic rocks of Aberfoyle parish form a block in which Ben Venue rises to 2,393 feet (730 m); the block is bounded on the north by
Lochs Katrine, Achray and Vennachar, and on the south by a deep valley containing Lochs Chon and Ard, which drain into the Forth. South of this valley relief is more subdued, and generally under 1,600 feet (488 m); the southern parish boundary is formed by the Water of Duchray, which joins the main valley shortly before Aberfoyle. Near the fault the landforms are comparable to those of the sedimentary rocks in a zone about three miles (4.8 km) wide to the southeast of the fault, which form a series of ridges and valleys with a marked northeast-southwest orientation; these forms are more distinct south of the Forth, which breaches the ridges. To the southeast of this zone relief is generally subdued; large parts of the parish of Port through which the Forth meanders were formerly moss and marsh. The Lake of Menteith is lined on the east side by the remnants of an end-moraine left by the small Menteith glacier, which developed in upland Aberfoyle parish in the final glacial advance (Sissons (1967), 99, 158, Fig. 9.3).

The earldom has a remarkable juxtaposition of Highland and lowland landforms; although most of Aberfoyle parish is typical of the south Highlands in form the lowland of Port parish represents the farthest extension inland of carseland, which originated in estuarine mudflats associated with early post-glacial sea-levels (Sissons (1967) 157). The district also remained socially and economically part of the Highlands relatively late, and as late as 1724 Gaelic was apparently spoken commonly not only in Aberfoyle
but in the parish of Port (NSAS (1845) V.10 (Perth), 1103). There is no evidence of early species composition but in the 1730s most of the wood of the estate except that on the shore of Loch Katrine was described as oak (SRO GD.220 [Wm.16]); ash and other deciduous species formed minor components of the Menteith woods (SRO GD.220 [Wm.26, Wm.32]). Since 1919 the Forestry Commission has planted large areas of coniferous timber in the earldom and a number of areas of existing deciduous woodland have been incorporated; these plantations together with Rowardennan Forest on Loch Lomond form the basis of the present Queen Elizabeth Forest Park.

As shall be seen later the pattern of woodland represented on Figure 9.3 indicates the general distribution of woodland throughout the period in question (below, 9.5). It is evident that the distribution of landforms had some effect on the pattern of woodland. As in other parts of the Highland area the woods of the metamorphic part of Aberfoyle parish were confined largely to the lower sections of valley slopes and loch shores; the largest concentration was the valley containing Lochs Ard and Chon, but fragmented woodland extended along the intermediate slopes of the loch shores forming the northern boundary of the earldom. Wood was almost all below 700 feet (213 m), although a few scattered trees reached 1,000 feet (305 m) or more. In the zone of parallel small ridges and valleys woodland occupied both valleys and interfluves, reflecting
the orientation of landforms to some extent; timber was almost totally absent from the lowland of Port parish except where morainic mounds provided adequately drained sites (Fig. 9.3).

Kincardine was in the possession of the family of Montrose by the fourteenth century (DNB.V.22 (1890) 335). Kincardine Castle was burned down in 1646 during the rebellion led by the first marquess; the estates had been confiscated in 1644 and when the second marquess regained them in 1656 Mugdock in southwest Stirlingshire became the main residence (Fraser (1874) V.1, 153-6, Stewart (1958) 17). Kincardine remained isolated from the other Montrose lands until the late eighteenth century, when it was sold. The wood was still included in the general estate accounts in 1770 but part of the barony had been acquired by Haldane of Gleneagles by 1771 (SRO GD.220/6 (50) (K1770), £.901/26/2, 49). By 1792 the place of Montrose among the heritors of Blackford parish had been taken by Campbell of Barcaldine and in 1802 the remaining part of the barony was the property of James Johnstone (SRO £.903/26/3, 17, OSAS V.3 (1792) 209).

The lands of Buchanan and Menteith were acquired in the late seventeenth century. Buchanan was purchased by the third marquess about 1680 and became the main seat of the family after 1751 (Stewart (1958) 17). In 1680 the marquess was also able, apparently by a subterfuge, to acquire a title to the lands of the earldom of Menteith.
from the eighth earl of Menteith; the lands passed to
the fourth marquess on the death of the earl in 1694
(Fraser (1880) V.1, 421-5, 430). Both Buchanan and Menteith remained in the possession of the family throughout
the eighteenth century and the first half of the nineteenth.
The successors of the third marquess, who died in 1684,
were notable for their longevity. The fourth marquess
was created duke in 1707 and died in 1742, and the next
three dukes succeeded at intervals of more than forty years;
in the 180 years after the acquisition of Menteith in 1694
the wood was in the possession of only four men (DNB V.22
(1890) 319-26).

During most of the period, however, the running of
the estates was entrusted to chamberlains or groups of
commissioners. The fourth marquess and first duke did
not reach his majority until about 1702, having succeeded
in 1684; he appears to have taken an active interest in
the estate for a few years, but thereafter management was
carried out largely by commissioners (SRO GD.220 [Wm.7,
Wm.9]). These men were invariably Grahams and fellow
proprietors in Perthshire or Stirlingshire; routine admin-
istration appears in general to have been the duty of a
single member of the commission, although they convened
as a body for the signing of contracts and formal attest-
atations (SRO GD.220 [Wm.10, Wm.17, Wm.32]). Graeme of
Gorthie was principal commissioner during the majority of
the first duke and was replaced by Graham of Orchill when
he died about 1753 (SRO GD.220 [Wm.10, Wm.32, Wx.2], Allardyce, ed. (1888) V.2, 298). The first and second dukes customarily spent most of each year in England, and during his term of office Gorthie lived throughout the year at Buchanan (Allardyce, ed. (1888) V.2, 296). The third duke was active in national politics and absent for long periods; after his accession to the dukedom in 1790 he appointed a chamberlain who was in office at least until 1812 (Graham (1812) 213, DNB V.22 (1890) 326).

The degree to which successive dukes dictated the decisions of their commissioners is uncertain. It is clear that the routine of administration was left to the commissioners for much of the time and on the occasions when the dukes took an interest in wood management they did not dispense with their services. Thus in 1764 the second duke attempted to impose strict penalties for negligence or abuse of contract on a group who had entered a contract for the cutting of the Menteith woods; Graham of Orchill believed the purchasers' assurances and was in a position to offer to persuade the duke to moderate the terms of the penalties (SRO GD.220 [Wm.36, Wm.37]). The character and competence of the principal commissioners presumably had some effect on the form of management; according to John Ramsay of Ochtertyre Gorthie's regime was characterised more by leniency and traditional loyalties than efficiency, but Orchill, 'a dull plodding man', introduced an entirely different and less casual system (Allardyce, ed. (1888)
Evidence about the management of the woods on the Montrose lands is provided by the Montrose muniments in the Scottish Record Office, which are as yet unsorted (SRO GD.220); relevant material comes from two sources within the collection. Firstly, a box labelled 'wood contracts' contains contracts, articles of roup, valuations, reports and memoranda; these provide an almost continuous sequence of information relating to Kincardine in the period between 1653 and 1761 and Menteith between 1694 and 1764, as well as information about wood management on other parts of the Montrose lands (SRO GD.220 [W]). Secondly, the estate accounts provide supplementary information relating to Kincardine in the periods 1702-23 and 1741-70, and Menteith in 1703-25 and 1741-71 (SRO GD.220/6 (46-7), 49-50). No accounts are available for the period 1772-1813, but from 1814 to 1833 a common account was kept for all the Stirlingshire and Perthshire lands except Kincardine, which had by then been sold (SRO GD.220/6 (56)). Information about periods for which other records are not available is provided by rentals, cash books, tenants' ledgers and minute books of tacks (SRO GD.220/6 (48, 68, 70, 80)). It is unlikely that no other records were kept in the periods in question and after 1833. In 1850 most of the old Buchanan House was destroyed by fire and some of the estate papers may have been destroyed or mislaid (Stewart (1958) 17); the estate papers which at present form the category
GD.220/6 were not collected in their present form until 1905-6.

9.2 The management of Kincardine Wood

Kincardine Wood appears to have been comparable to some others in lowland Perthshire such as the woods of Methven and Murthly, in being a small and compact area of coppice among cultivated land with an origin as managed woodland in the period before 1650. As already noted the wood of Murthly was a source of timber before 1550; Methven wood was associated in local tradition with events of the early fourteenth century and was more than once described in some detail by later observers (Cant, ed. (1774) 176n, NSAS (1845) V.10 (Perth), 145-6, Hunter (1883) 118-20, above, 7.4). In contrast, almost all the information at present available about the wood of Kincardine is provided by the estate records. It was apparently not thought worthy of description in the Old Statistical Account, and although described briefly in the later account it was not included by Hunter in his detailed survey of the woods and estates of Perthshire (OSAS V.3, (1792) 210, NSAS (1845) V.10 (Perth), 298). It is possible that in the early period the produce was used entirely locally, and although the wood was briefly mentioned in some accounts observers paid more attention to woods which were more conspicuously parts of identifiable estates; the old castle remained a ruin and the new Kincardine Castle was built only in the
second half of the nineteenth century (Newte (1791) 252-3, Mitchell, ed. (1906-8) V.1, 137).

As shall be seen later, there was little change in the dimensions of the wood during the period, and it was probably between 400 and 450 acres (162-182 ha) throughout the period between 1650 and 1770 (below, 9.5). A rotation of twenty-four haggs of equal size could be established only if the haggs were small, between sixteen and nineteen acres (6.5-7.7 ha), and the wood did not adjoin an area of marginal land suitable for planting. The area of the wood could therefore be extended only by inclusion of parts of the cultivated land which surrounded it and as long as cultivation remained more valuable than wood management the wood had a fixed maximum extent, although a certain amount of consolidation was possible within the established wood. The steep sides of the Glen were perhaps not cultivable but part of the bottomland and areas within the Broad Wood were tilled, and there is no obvious reason why the rest of the Broad Wood should not have been suitable for clearance (Fig. 9.2). The demand for oakbark in the eighteenth century may have saved the wood from partial or complete clearance. Even in the seventeenth century woods like Kincardine were uncommon in Perthshire (NLS(M) Case 8A.2, 2, BM K. Top. 48.44). In the eighteenth century a small wood on fertile land was to some extent an anachronism, and in a number of ways the system of management employed had features which appear to have been survivals from an earlier
period of forestry.

During much of the period the wood was supervised by a forester, and it should be noted that in the earlier part of the period the terms of appointment were not unlike those of earlier royal foresterships (above, 3.2). The foresters of Kincardine were not initially salaried employees; the commission of forestership of 1656 was a prorogation of an earlier appointment and resembled an agricultural lease. The forester, his son or their assignees were appointed for nineteen years, and were granted the customary fees, privileges, commodities, casualties, profits and duties, with grazing for a number of cows and mares in the wood and the bark and bough of any oak given away by the proprietor. The forester was required to pay for the use of a pendicle and the bark and bough of the oaks; duties included supervision of Montrose's mares when they were grazing in the wood and protection of the wood and enclosures from damage (SRO GD.220 [Wk.2]).

The most profitable part of the post appears to have been the forester's fee, a levy of 4d Scots per horseload and 8d per cartload of timber taken from the wood. The fee was less appropriate to managed coppice than to wood subject to frequent use for different purposes by estate tenants. Consequently when the wood was sold for a twelve-year cutting in 1680 the purchaser was exempt from payment of the fee, and it was thought that the forester should be
provided with a new means of subsistence (SRO GD.220 [Wk.3]). Under the new commission of 1682 the appointment was still for nineteen years and the forester was able to nominate his successor within the period. The privileges were largely unchanged; payment was still required for the pendicle but in compensation for the loss of the forester's fee he was given ten bolls of meal annually for duties as forester and dyker, and promised the services of the tenants of Kincardine in building dykes. The duties differed in that the supervision of mares was now thought subordinate to the protection of the coppice, grazings and enclosures against damage in cutting, theft and grazing (SRO GD.220 [Wk.4]).

The appointment expired at Whitsunday 1701 and the forester does not seem to have been replaced; the annual payment of four bolls of meal for maintenance of the outer dyke of the wood, recorded in the accounts during the period 1703-23, was apparently the wage of the dyker rather than the forester (SRO GD.220/6 (46) 222-4, GD.220/6 (47) 321-3). Appointment of a forester was however recommended in 1729 and another commission was granted in 1732 on terms very different from those preceding it. A cash salary was paid in lieu of customary privileges, which were transferred to the purchaser of the wood; the forester was allowed only to graze two cows and to keep any fines obtained by impounding stray animals and prosecuting those who illicitly cut timber, peeled bark, and mowed grass. The appointment
was at the duke's pleasure and the primary duty was to ensure that the stool of coppice was protected and the young growth enclosed (SRO GD.220 [Wk.7, Wk.9]). Foresters were employed in Kincardine until 1753, but there is no evidence of the employment of a resident forester after that year (SRO GD.220/6 (49) (K1743-4, 1752-3)).

Enclosure was employed in the management of the wood throughout the period. The first contract of 1653 required the purchaser to leave sufficient timber for paling in each year and the wood as a whole was enclosed with turf and stone at least as early as 1682 (SRO GD.220 [Wk.1, Wk.2]). The wood was not part of the local grazing resource; there were therefore no tenants on whom direct responsibility for erection and maintenance of fences could be settled. Enclosure consequently was at different times the duty of the purchaser, the forester and the tenants of the barony as a whole, and specialised dykers. In 1680 the purchaser was obliged to enclose each hagg at his own expense and allowed to reclaim the timber when the fences were judged unnecessary (SRO GD.220 [Wk.3]). Under the commission of 1682 the forester was to make up the dyke of 'faill' or turf round the individual haggs and the wood as a whole, with the assistance of the tenants of the barony; the contract and commission together suggest that the purchaser erected a wooden fence or paling on a relatively low turf wall provided for him, a method of fence building not uncommon in the Highlands (SRO GD.220 ['Wk.4'], Walker (1812))
A new system was in evidence in the early eighteenth century. From 1704 until the temporary termination of accounts in 1723 annual payment of four bolls of meal was recorded for maintenance of the outer dyke (SRO GD.220/6 (46) 222-4, GD.220/6 (47), 321-3). This dyke was probably built largely of turf; in 1729 the purchaser of the wood was required to supply timber as paling for the old outer failly dyke (SRO GD.220 [Wk.6]). More permanent protection was also provided. Stone dykes had been built by 1682 and construction continued after 1703, when a mason was paid a substantial amount for stonework; intermittent payment for new stone dyke continued at least until 1723 (SRO GD.220/6 (46), 220-4, GD.220/6 (47) 156-8, 321-3, [Wk.4]).

The wall was probably within the old turf dyke and payment for failling and boarding suggests that it was reinforced or topped with turf and paling (SRO GD.220/6 (46) 225-8, 233-6).

Within the wood dykes the purchaser erected a temporary paling round each hagg after cutting and maintained it as long as necessary (SRO GD.220 [Wk.6, Wk.7]). Purchasers continued to be responsible for erection and maintenance of the hagg dykes until 1758; the dykers maintained the outer wood dykes and the turf dykes which divided the wood into groups of haggs, rebuilding some sections and setting palings on others (SRO GD.220/6 (49) (K), GD.220/6 (50) (A)). After 1758 the dykers were paid for erecting fences round
newly-cut haggs; it is evident that the contract signed in 1759 did not require the purchaser to erect fences as formerly and the dykers became responsible for all the enclosure work at least until 1769 (SRO GD.220/6 (50) (K1758-69)).

Although attention was paid to enclosure there is little evidence about the period after cutting during which protection was thought necessary. The contract of 1705 ruled that the purchaser could use the grass of cut areas only after eight years had elapsed (SRO GD.220 [Wk.5]). In 1736 an inspection of the wood suggested that horses should be admitted after seven years and other animals ten years after cutting; this proposal was inserted as a condition in the contract of the same year but modified to allow the grazing of horses only after eight years (SRO GD.220 [Wk.10, Wk.12]). There is no further indication of the period of haining, although adoption of a system of division into groups of seven or eight haggs may have encouraged enclosure for corresponding numbers of years.

Grazing damage was occasionally reported. Thus an inspection in 1749 showed that parts of the palings round some haggs and the newly-built wood dyke were defective; there was also evidence of the presence of sheep, horses and cattle in some enclosures. This report was followed by the proposal of stricter regulations, but the double protection of the outer dyke and hagg dykes was not totally reliable as long as grazing animals were permitted to enter parts
of the wood (SRO GD.220, [Wk.15]).

Throughout the period the wood was used for grazing; as it was not included in the local grazing reserve all rights within the wood dyke could be conferred on the purchaser without interference with local land use. The main limitation was in the fact that some parts of the coppice were 'before the axe' and others 'behind the axe' at any one time; these terms were also used in other parts of Perthshire (SRO E.777/50/3-4). Coppice was behind the axe during the period of enclosure after cutting, and when the enclosure was opened after a few years of protection the hagg was considered as being before the axe until it was next cut over. The form of land use within a section of coppice depended on the stage of this cycle reached at a given time.

It has been noted that the foresters were allowed to graze a certain number of animals within the wood; it was required that they should confine their stock to the sections out of enclosure at any one time (SRO GD.220 [Wk.2, Wk.9]). The rest of the pasture of the wood before the axe was sold to the purchaser of coppice during the currency of his contract. In the seventeenth century the wood was cut in a few large haggs, but full rotation was introduced at the beginning of the eighteenth century. Under such a system the quantity of grass available for pasture remained constant from year to year if the period of enclosure after cutting was not changed; thirteen haggs of a wood cut on
a twenty-four year rotation and protected for ten years could be grazed in a given season, giving a cumulative total equivalent to thirteen years of grazing of the whole wood during the rotation.

The annual rent of the grass of Kincardine, stated separately in the accounts between 1741 and 1765, was less than ten per cent of the annual value of timber and bark throughout the period (SRO GD.220/6 (49) (K), GD.220/6 (50) (K)); an estimate of the average annual yields of the Montrose woods in the 1750s set the value of the grass of Kincardine at 8.4 per cent of the value of wood. Grass was more significant in the small woods of Stirlingshire, where the continued use of non-rotational cutting allowed continuous grazing of the whole wood for periods of ten years or more. When averaged over the cutting cycle the grass of Ledlewan wood was worth twelve per cent of the value of the coppice; that of the woods of Cruikston and Mugdock was worth more than thirty per cent in each case (SRO GD.220/6 (70), 231).

The proportionately small income at Kincardine was augmented by the cutting of grass in the wood behind the axe. This is not evident in the seventeenth-century contracts; the shearing or mowing of enclosed grass was of more value when full rotational cutting was introduced and part of the coppice was behind the axe in each season. The first contract to allow such cutting was that of 1705; it was also permitted by those of 1732 and 1736 although
apparently not in 1729 (SRO GD.220 [Wk.5, Wk.6, Wk.7, Wk.12]). As already noted, this was potentially a harmful practice and it was recognised as such in Kincardine (above, 4.4). The contract of 1705 allowed cutting only after three years of enclosure, if two men appointed by Montrose were satisfied that young growth was not appearing in the area to be mowed; there were similar but less precise conditions in the contracts of 1732 and 1736 (SRO GD.220 [Wk.5, Wk.7, Wk.12]).

Cutting of grass behind the axe was associated with cultivation within the wood dyke, a form of land use more clearly incompatible with the growth of woodland. The purchasers of the coppice of Kincardine wood were allowed to till within the dyke until 1737. In the early contracts no restriction except that of custom was imposed on cultivation and the contract of 1705 allowed tillage both before and after the axe (SRO GD.220 [Wk.1, Wk.3, Wk.5]); there seems to have been some doubt about the value of tillage, however, as modified stipulations were incorporated in the next three contracts. In 1729 tillage was allowed only before the axe but in 1732 it was also permitted behind the axe if new growth was not evident; in 1736 cultivation was allowed only in the haggs behind the axe, and no earlier than three years after cutting (SRO GD.220 [Wk.6, Wk.7, Wk.12]). It seems probable that there were recognised small enclaves or clearings of cultivable land among the trees, rather than large cultivable blocks within
the dyke; it would not otherwise have been necessary to relate tillage to the stages of the cutting cycle. If the arable sections of the wood had been large and compact it would have been more practicable to exclude them altogether from the area cut as coppice.

In 1737 this group of privileges was taken from the purchaser. Tillage and shearing and mowing were permitted by the contract of 1736, but by an agreement of the following year the purchaser relinquished all rights to pasture animals, mow grass, cultivate and take in land; the privileges were said to have been abused and the wood damaged. In return he was allowed a fifteen per cent reduction in the annual payment, which indicates the approximate value of these uses of the wood (SRO GD.220 [Wk.13]). The following contract specifically prohibited tillage and did not permit the cutting of enclosed grass; a valuation made immediately before the signing of the next seven year contract in 1759 suggested that tillage should be allowed in the haggs, but there is no evidence that the suggestion was accepted (SRO GD.220 [Wk.14, Wk.17]). The reforms of 1737 might be seen as part of a general change in the management of the Montrose woods which affected Buchanan and Menteith after 1735 (below, 9.3). It is evident, however, that the system in use in Kincardine had proved inadequate.

The grazing of the wood appears to have been over-exploited. Until 1736 the contracts did not restrict the number of animals grazed and it is probable that the
purchasers of the wood sublet the grazing available to them. In that year, however, it was required that the grass should be soumed annually by men selected by Montrose, and that animals should be removed by the end of August; these measures indicate attempts to regulate an increasing intensity of grazing (SHO GD.220 [Wk.12]). After the purchaser renounced grazing rights in 1737 the estate appears to have taken them over in their existing form. The accounts for 1741-3 show differing incomes from the wood in the three years, which suggests that rents were based on annual soumings; the cutting of hay in the wood in 1742 indicates the mowing of grass behind the axe, but there is no later evidence of this (SHO GD.220/6 (49) (K1741-3)). In the new contract of 1743 souming was disregarded and the grass before the axe was sold to the purchaser for an annual payment fixed during each contract; in a contract of 1766 this 'grassmail' was again merged with the annual payment for wood (SHO GD.220/6 (49) (K), GD.220/6 (50) (K)). Stocking problems were not entirely solved; after reports of inadequate fencing and grazing damage in the wood in 1749 it was proposed that souming and fixed annual dates for stock movement should again be applied (SHO GD.220 [Wk.15, Wk.16]).

The age at which the coppices of Kincardine were cut can be estimated from the length of contracts; this is indicated by Figure 9.4. Under the agreement of 1653 the first cutting was to take place in 1654, and cutting under the next contract commenced twenty-seven years later
Figure 9.4. The cutting sequence of the Montrose woods.
in 1681 (SRO GD.220 [Wk.1, Wk.3]). The following cutting began in 1705 after a shorter interval of twenty-four years and continued for an identical period. The uncompleted contract of 1729 was also intended to cover a twenty-four year period but twenty-seven years were allowed for the cutting of the remaining twenty-two sections when the woods were again sold in 1732. The failure of the contracts of 1729 and 1732 led to re-evaluation.

The men sent to inspect the wood in January 1736 were asked to comment on a proposal to divide the wood into four sections, two in the Broad Wood and two in the Glen, each of which would be cut in annual sections over seven or eight years; the cutting age was therefore fixed in the range between twenty-eight and thirty-two years, and the inspectors suggested uniform cutting at thirty-two years (SRO GD.220 [Wk.10], Figure 9.4).

Such a cutting age was adopted and it was noted in the 1750s that the wood was divided into thirty-two hags, although the first full rotation under this system occupied only the thirty years from 1736 to 1765, two of the division being cut in seven years each (SRO GD.220/6 (70) 231). The wood was therefore by then cut over regularly at an interval rather longer than was customary in Scotland and a perpetual full rotation was also employed. This had not been the case throughout the period. The whole wood was cut over in six years from 1654 and twelve years after 1681; the twenty-four cutting between 1705
and 1728 provides the first evidence of genuine rotational treatment (SRO GD.220 [Wk.1, Wk.3], Fig.9.4). The contract of 1705 specified that the wood was to be divided into twenty-four sections, only one of which was to be cut in any one year (SRO GD.220 [Wk.5]). Such a system appears to have been followed in the later contracts, although division into four major sections allowed more flexibility in sale and management without loss of the advantages of regular cutting.

Attention was also paid to the dressing of cut stools and the clearing of the sites. The 1653 contract included no instruction about the form of cutting to be employed and those of the eighteenth century did not contain precise rules or guidelines, although they required that the stools should be cut and dressed so as to prevent damage (SRO GD.220 [Wk.1, Wk.5, Wk.6, Wk.7, Wk.12, Wk.14]). The contract of 1680, however, set out detailed conditions which suggest that a relatively high level of management had been attained before 1700. It was required that the newly-cut stools should not be damaged by bad cutting or peeling; more specifically it was stated that the stools were to be cut on a slant to prevent rot and that no bark should be removed below the cut (SRO GD.220 [Wk.3]). After 1680 each contract included terminal dates for the cutting of oak and the clearance of the hagg after cutting, which was to be undertaken in a way which would not damage the young growth. November 1 was the set date for clearing through-
out the period but there was some variation in the final date for cutting; in 1680 and 1705 it was to continue until August 1 but after 1729, when the date was brought forward to July 1, July 15 became the day on which cutting was to cease (SHO GD.220 [Wk.3, Wk.5, Wk.6, Wk.7, Wk.12, Wk.14]).

The terms on which the foresters were employed suggest that they were regarded primarily as the keepers of existing resources, and that they were not expected actively to improve the form of the wood. It is not therefore surprising to find that even in the period when foresters were employed little attention was paid to some aspects of management. There is no evidence of formal 'weeding' or thinning and pruning. Purchasers were permitted to weed the wood before the axe, a process which appears to have been identical to the cutting of hoops of barren timber before the axe already described (above, 8.4). Although only the contract of 1680 specifically prohibited the use of oak and ash in this way weeding seems to have been confined mainly to barren timber; the privilege appears to have been abused to some extent and it was thought necessary in the contract of 1732 to allow weeding of only one hagg in any year. Weeding was not permitted under the next contract and does not appear to have been resumed later (SHO GD.220 [Wk.3, Wk.5, Wk.6, Wk.7, Wk.12, Wk.14]).

It has already been indicated that there was little
scope for extension of the wood and there is no evidence of planting on a significant scale, although some planted timber remained round the ruined castle (SRO GD.220 [Wk.7]). There is also little evidence of the selective treatment of oak and the wood remained mixed in composition; a report of 1749 showed that willow, birch, elm and alder were being cut in the Glen and in 1759 willow was prominent enough in one division of the Glen to be valued for bark in addition to the oak (SRO GD.220 [Wk.15, Wk.17]). The weeding of barren timber may have allowed oak to increase proportionately and in the later contracts the purchasers were allowed unlimited use of hazel, broom and thorn for fencing, but there is no evidence that valuable timber was planted in the vacancies thus created (SRO GD.220 [Wk.12, Wk.14]).

Standards were reserved after 1680. The contract of that year required that only 720 oak standards of certain dimensions should be left in the wood as a whole, but in the contracts of the following century one hundred standards were reserved in each hagg. During a twenty-four year rotation 2,400 trees were therefore reserved and the number later increased proportionately when the rotation period was extended; after 1729 the selection of standards was the responsibility of the forester (SRO GD.220 [Wk.3, Wk.5, Wk.6, Wk.7, Wk.12, Wk.14]). The supply of suitable oak stools does not appear to have been sufficient to provide standards in such numbers. Thus the
contract of 1705 allowed the purchaser to select standards of oak, elm, ash and birch from the whole wood, and the phrasing of later contracts suggests that the nature of the timber growing in individual haggs might not allow the forester to select the appropriate number of standards of oak alone in each case (SRO GD.220 [Wk.5, Wk.6, Wk.7]). The species diversity of the Glen has already been indicated and it may be noted that when eight haggs of the Glen were sold in 1736 the standards were not expected to be exclusively of oak. When the same purchaser bought the fifteen haggs of the Broad Wood in 1743, however, the standards were to be entirely oak, which suggests that the Broad Wood contained a significantly higher proportion of oak than the Glen (SRO GD.220 [Wk.12, Wk.14]).

9.3 The Management of the Menteith Woods

As already noted, the woods of Menteith did not come into the possession of the Montrose family until 1694, and there is little evidence relating to their exploitation before this; available information relates entirely to the seventeenth century (above, 9.1). In 1615 a large amount of spokewood was cut in Menteith for military use, which suggests that the area then contained a substantial reserve of small deciduous timber, which may or may not have been formally coppiced (Paton, ed. (1957) 375). During the unrest of 1654 General Monk allegedly issued a written order for the cutting of the woods of Milton and Glenshart in
Aberfoyle parish, which sheltered rebels and brigands.

The woods were almost certainly those of the adjacent lands of Milton and Glassert; the order has frequently been taken as the latest example of the destruction of Highland woodland for reasons of military strategy (Anon. (1819) 139-40, Monteath (1824) 1, Darling & Boyd (1964) 70, Anderson (1967) V.1, 348).

It is not certain whether or not any attempt was made to execute the order. It may be noted, however, that the woods of Glassert and Milton were fit for cutting as commercial coppice in 1678 and 1697 respectively, and that Glassert was by far the largest and most valuable wood cut in the earldom in the last quarter of the seventeenth century. A report submitted by the forester in March 1703 indicates that most of the woods of the earldom were cut over as coppice in the twenty years after 1678, some by bark and timber merchants and some under the direction of the earl of Menteith himself. The standard of management appears to have been low; it was reported in 1703 that the poor quality or absence of enclosure had in some cases resulted in an appreciable decline in the productive capacity of the woods since the previous cutting, and the pattern of cutting indicates no attempt to arrange a regular sequence of sections, as is evident from Figure 9.5 (SRO GD.220 [sm.4], Fig. 9.5).

Under the management of the Montrose commissioners the use and control of the woods differed in many ways from
that of Kincardine. The woods themselves were discontinuous but larger in total area. Toward the end of the nineteenth century the woods included in the rotation appear to have amounted to more than 1,300 acres (526 ha); there was also a considerable amount of open woodland and scope both for consolidation and planting on upland of marginal value (below, 9.5). The wood also differed from that of Kincardine in being an integral part of the agricultural area of the district; scattered fragments of wood could not easily and cheaply be enclosed and permanently excluded from other local uses. Finally the wood appears to have differed in lacking an established form of management; the management of the Menteith woods was determined largely by the policy selected in the early eighteenth century.

The woods were supervised at least after 1703 by a salaried forester, without the customary perquisites of the corresponding officer in Kincardine. A forester was still employed in 1845 and the post appears to have been vacant only in the early 1720s, when the accounts contained no record of payment of salary. As in Kincardine the forester was employed largely to supervise use of the wood and conserve existing coppice; only after the beginning of the nineteenth century do the accounts indicate a regular and substantial outlay on maintenance and improvement (SASO GD. 220/6 (46) (M), GD.220/6 (47) 285-349, GD.220/6 (49) (M), GD.220/6 (50), (M), GD.220/6 (56), NSAS (1845) V.10 (Perth) 1157).
The grass of the woods was not leased to the purchaser but remained accessible to the agricultural tenants when it was not enclosed. There is no evidence of cultivation or mowing within the wood, practices which were less appropriate to scattered fragments of woodland on marginal sites enclosed for relatively short periods; nor is there any record of the payment of abatement for the temporary loss of enclosed grass in the general accounts, ledgers of payment by tenants, minute books of tacks, and estimates of the value of the woods (SRO GD.220/6 (48), GD.220/6 (70), 231, GD.220/6 (80) 95-7). The wood was unavailable only for about six years during a rotation of twenty-four, and there appears to have been little restriction during the remaining years; examination of the woods occasionally revealed points where grazing had caused damage to poorly-enclosed wood (SRO GD.220 [Wm.18]).

There is no evidence that the grazing stock of the area in the eighteenth century was notably different from the mixture of black cattle, sheep and goats characteristic of the south Highlands (above, 4.3). Goats were recognised as the cause of a certain amount of damage and had been proscribed in Aberfoyle parish by 1794 (SRO GD.220 [Wm.18], OSAS V.10 (1794) 124). Those of Ben Venue survived in a semi-feral state until relatively recently; the presence of semi-feral goats there and in the Trossachs was noted several times in the early nineteenth century (OSAS V.11 (1794) 578-9, Campbell (1802) V.1, 110, Oswald (1811) 20, Herford, ed. (1929) 35, Atkinson (1821) 24, Watt (1937) 16).
By the end of the eighteenth century sheep had replaced goats on the upland of the earldom; by 1845 the upper areas were occupied largely by blackfaced sheep and there had been extensive farm amalgamations. Some black cattle grazed in the uplands but the lower parts which contained most of the wood were pastured by Ayrshires (OSAS V.10 (1794) 124, NSAS (1845) V.10 (Perth), 1153, 1157).

Permanent fences were not utilised; temporary wooden enclosures were the main means of protection in the period. These were of the type known in the Highland region as 'stake and rice'; a line of vertical palings was reinforced by coarse wattling with small branches known as rice (Graham (1812) 214). The wood contracts directed that each year the purchaser should make available sufficient timber and brushwood to allow enclosure of the 'outsides and divisions' of the woods cut that year; these included the perimeter fences and any internal divisions necessary if a wood contained more than one hagg (SRO GD.220 [Wm.7, Wm.32]). The purchaser himself did not erect the fences; during the period 1703-20 the forester was paid a set amount by the estate for each measure of fence built (SRO GD.220/6 (46) 45-6, GD.220/6 (47) 201-2). In the rest of the period the erection and maintenance of temporary fences was the responsibility of the tenants of the farms on which the wood lay; it is possible that between 1703 and 1720 the forester redistributed payment among the tenants as appropriate. On the Buchanan lands tenants were obliged to
erect fences immediately after cutting at fixed rates; they remained responsible for the condition of the palings as long as the fences were retained and were liable to fines each time animals trespassed within the enclosure. Although only brief minutes of tack remain, the leases of Menteith appear to have been similarly framed (SRO GD.220/6 (80) 95-7, Graham (1812) 214).

Each year the tenants were paid compensation proportionate to the length of the fences erected by them on their holdings; the record of payment in the accounts provides a useful indication of the size of woods on different farms and the order in which the woods of the estate were cut (SRO GD.220/6 (49) (M), GD.220/6 (50) (M), GD.220/6 (56)). The subsequent period of enclosure was relatively short. A memorandum belonging to the period immediately before 1700 recommended that fences should be maintained by the tenants for only three winters and two summers (SRO GD.220 [Wm.1]). Maintenance of fences was not the duty of the purchaser and the contracts contain little information about this topic, but the purchaser of the barren timber of Blarinross in Menteith in 1744 was obliged to protect each hagg for four years (SRO GD.220 [Wm.27]). In the early nineteenth century the Buchanan haggs were enclosed for six years and in 1845 this was the case both in Buchanan and Menteith (Graham (1812) 214, NSAS (1845) V.8, 96 (Stirling), V.10 (Perth), 1157).
The age at which the woods were cut and the system employed were established largely in the few years around 1700. Shortly after the lands came into the possession of the family of Montrose an unsigned report was submitted which suggested that the woods should be valued between twenty-one and twenty-four years and allowed to stand for an additional five or six years (SRO GD.220 [Wm.1]); the proposed cutting interval was therefore between twenty-six and thirty years. In March 1703 the forester of the time prepared a memorandum which summarised the cutting sequence of the previous twenty-five years; added to it in another hand was a proposal that the wood should be divided into three major sections, each to be cut in eight or nine years. The composition of these sections was determined largely by the irregular cutting of the previous regime but the sections or 'divisions' themselves provided a basis for the cutting of Menteith during the remainder of the period of coppice management (SRO GD.220 [Wm.4]).

The age of cutting was controlled largely by the degree to which the three divisions were subdivided. The cutting sequence through most of the eighteenth century is indicated by Figure 9.4; it will be noted that the first division was sold for cutting in six years and that divisions were subsequently cut in seven years. By 1735 each had been cut once and the first had been cut a second time; there had been two short periods without cutting. After 1735, however, the divisions were cut in eight years each; the rota-
- Farms on which woods cut at known dates.
- Location or date uncertain.

- Main areas of woodland, c.1865.
- Aberfoyle.
- Perimeter of the lands of Menteith.

Based on SRO GD.220 [Wm.].

Figure 9.5. Coppice cutting in Menteith before 1700.
Figure 9.6. Divisions of the Menteith woods, 1703-25.
Approximate boundary of divisions.

Boundary uncertain.

Farm named as being within a division.

Location uncertain.

\[ \text{Main areas of woodland, c.1865} \]

\[ \text{Aberfoyle} \]

\[ \text{Perimeter of the lands of Menteith} \]

Based on SRO GD 220/6(49), GD 220/6(50), [Wm 15, Wm 17, Wm 24].
tion therefore increased from twenty-one to twenty-four years. This continued at least until the termination of accounts in 1771, and the contract in force in that year was designed to carry on cutting on a rotation of this length until 1782 (SRO GD.220/6 (50) (Marl60), above, Figure 9.4). According to the second Statistical Account a rotation of twenty-four years was still employed in 1843 (NSAS (1845) V.10 (Perth), 1157).

Stability in the age of cutting is reflected by the limited change in the boundaries of the divisions during this period. The dates at which the woods were cut in the late seventeenth century are indicated by Figure 9.5, and the approximate outlines of the divisions cut during the first full rotation after 1705 are indicated by Figure 9.6. The divisions are here defined largely in terms of the farms stated to lie within them. The locations of farm buildings are marked, and the boundaries have been drawn so as to include all land which might have belonged to these farms; the main features of the first accurate survey of woodland made in the late nineteenth century are included to indicate the approximate distribution of woodland. It is evident that the first division corresponded to the sections cut in 1681; there is less information about the woods of the second division but most appear to have been cut in the 1680s, and those of the third division had previously been cut between 1687 and 1699 (Fig. 9.5, Fig. 9.6). Figure 9.7 shows the divisions during the period 1735-67, covering
Figure 9.8. The bark yield of the Menteith woods.
Each circle represents one farm. Each division was cut during eight successive years; shaded segments indicate those in which woods on a farm were cut.

Main areas of woodland, c.1865.

Aberfoyle.

Perimeter of the lands of Menteith.

Based on SRO GD.220/6(49), GD.220/6(50).
a full rotation and the cutting of another division, and based largely on the divisions defined by payment to tenants for enclosure. The information provided indicates that there was no significant change in the organisation of the divisions over the period between 1705, when the first division was first cut, and 1767 (Fig. 9.7).

It is evident from the pattern that the first division was relatively compact, although it contained the oakwoods farthest from external markets; the other two divisions consisted largely of a group of more accessible fragments around Aberfoyle and in the lower part of the district, those of the third division being largely north of the Forth. The second division also included small woods on the Duchray Water and in the north-east part of Aberfoyle parish. Each division included a part of the most concentrated belt of woodland between Loch Ard and the lowland part of Port parish. The woods of this part of the valley produced the highest yield of bark; this is illustrated by Figure 9.8, which is based on estimates of the yields of the three divisions; estimates of 1743 and 1752 relate to successive cuttings of the third and first divisions, but the only available estimate for division two was made in 1710 (Fig. 9.8). The sequence of cutting during the rotation of 1744-67 is plotted in Figure 9.9; this also demonstrates the importance of these major woods, which were large enough to provide bark during several years of the rotation. Groups of the smaller woods were cut together in
other years (Fig. 9.9).

The relative productivity of the three divisions is not easily assessed. It was stated in 1703 that the previous cutting of the woods of the first division had yielded 9,000 bolls, a total thought likely to be reduced at the next cutting as the result of poor enclosure (SRO GD.220 [Wm.4]). A valuation in 1704 indicated that the total yield would in fact be only 6,580 bolls, of which 3,800 were provided by Glassert. The valuation of the second division in 1710 produced a comparable total of 6,872 bolls, of which 3,500 were from Doun and Park (SRO GD.220 [Wm.6a, Wm.8]). No early estimate is available for the third division. A number of estimates were made in 1744 and the most comprehensive provided a total of 6,700 bolls of eight stones or 5,360 of ten stones, the measure most probably employed in the earlier estimates (SRO GD.220 [Wm.25]).

In 1752 two separate estimates of the first division were submitted; one stated that the wood contained 11,000 bolls of eight stone (8,800 of ten stone) inclusive of bounty bark, and the other provided an inclusive total of 11,550 bolls of eight stone (9,240 of ten stone) (SRO GD.220 [Wm.31, Wm.31a]). There is no evidence that the third division was smaller than the others when first cut; the relative productivity of the other two sections appears to have increased after the initial division.

As the divisions were not defined by permanent perimeter walls or internal fences the haggs were demarcated
Approximate boundary of cutting as follows:

- A 1823-30
- B 1814-1831
- C 1815-22

Farm on which cutting took place.

Main areas of woodland c.1865.

Boundary uncertain.
Allocation uncertain.

Figure 9.10. The cutting sequence of the Menteith woods, 1814-33.
anew immediately before each cutting of a division (SHO GD. 220/6 (50) (M1767-8). It would therefore be possible to transfer a wood from one division to another simply by delaying the cutting date one or more times, and this appears to have occurred by the early nineteenth century, perhaps as a result of an attempt to remove the inequality of the divisions. Comparison of the actual cutting pattern of the period 1814-33 and that which may be predicted by extension of the earlier rotational sequence into the period suggests initially that regular rotational cutting had been abandoned. If it is assumed that the cycle had been advanced by one year, however, perhaps because of the cutting of one division in seven years, a more orderly pattern emerges; this is illustrated by Figure 9.10, in which the sequences identified by the letters A, B, and C correspond broadly to the first, second, and third divisions respectively. The second and third divisions appear to have become more compact, and the latter was evidently enlarged by inclusion of parts of the first division at the east end of Loch Ard (Fig. 9.10).

After institution of the divisions the form of management was more stable than in Kincardine; cutting became more regular after 1735 but there was no radical change comparable to that made in Kincardine in the 1730s. The period allowed for the cutting of oak was gradually extended, perhaps as a concession to purchasers. A memorandum of the 1690s advised that cutting should cease by June 24,
as the bark deteriorated after that date and young growth did not appear (SRO GD.220 [Wm.1]). No date was stated in the early contracts but after 1728 cutting terminated on July 1 and after 1735 on July 7; contracts of 1744 and later permitted the cutting of oak as late as July 10, but with the exception of three years after 1729 cutting invariably ceased earlier than in Kincardine (SRO GD.220 [Wm.13, Wm.17, Wm.26, Wm.29, Wm.32]). Practice in Buchan and Menteith was generally similar; in Buchanan July 10 remained the terminal date of oak cutting after 1800, and contracts required that stools should be cut low to allow the young growth to develop roots (Graham (1812) 214).

The privilege of cutting hoops of barren timber before the axe was not granted until 1752; the purchaser was then allowed to cut suitable timber from hags not otherwise cut in a given year (SRO GD.220 [Wm.32]). Later, however, the duke personally refused to permit cutting of hoops outside the division being cut at any one time on the grounds that the merchant would leave hoop cutting to the least skilled of his men (SHO GD.220 [Wm.35]). Formal thinning was not practised to any extent before 1771, but a remarkable change is evident from the surviving accounts for the period after 1814; thinning was by far the largest single expense in the management of the woods from that date until expenses were grouped together in 1826 (SRO GD.220/6 (56) (1814-25)). The woods were still said to be
properly thinned in 1845 but there is no evidence of the method employed (NSAS (1845) V.10 (Perth), 1157). The woods of Buchanan were thinned once during each rotation in the late eighteenth century, but by 1812 there were two or three thinnings and the bark obtained in the twelfth summer covered the total costs of thinning (Graham (1812) 215-6). The provenance of bark sold by the estate was seldom stated in the later accounts, but the sale of 'weeding bark' specifically from Menteith in some years indicates that a similar system was employed (SHO GD.220/6 (56) (1829, 1833)).

Standards were always reserved during the management of the woods as coppice, but the number and dimensions of the stems selected varied considerably. In the 1690s trees fourteen inches (36 cm) in circumference one ell (c. 0.9 m) above the ground were thought ideal but in some later contracts standards were required to be the size of 'great hogshead ware'; hogshead ware included shoots between six and ten inches (15-25 cm) in circumference (SHO GD.220 [Wm.1, Wm.11, Wm.26, Wm.29], GD.1/390 (54)). In the remaining copies of other contracts blank space was left for the specification of the standards, and in that of 1735 they were simply required to be of 'ordinary' dimensions; in the contract of 1752, the latest at present available, standards were to be between eight and twelve inches (19-28 cm) 1.5 ells (c. 1.4 m) above the ground (SHO GD.220 [Wm.7, Wm.9, Wm.17, Wm.32]). The purchaser
was allowed to select the stems for reservation, and although most contracts required that a certain number should be left in each hagg that of 1752 allowed standards to be left wherever convenient in the division (SRO GD.220 [Wm.32]).

The number required increased steadily. In 1718 700 were to be left in the third division but in the contracts for the sale of the two halves of the same division in 1744 and 1748 a total of 960 were to be retained; when the first division was sold in 1752 1,280 stems were reserved (SRO GD.220 [Wm.26, Wm.29, Wm.32]). Until that date the standards reserved during one cutting appear to have been available at the age of forty-eight for the use of the next purchaser. In 1752 the purchaser was required to leave ten trees per hagg which had already been reserved once and would therefore not be cut until seventy-two years of age (SRO GD.220 [Wm.32]). This resembled the formal rotation of standards in English coppice management, and the system applied in Menteith was further refined (Jones (1959) 215).

By 1794 the purchaser was obliged to leave 400 new standards or maidens in each hagg, or 3,200 per division, with eight trees previously reserved once and eight reserved twice in each hagg (OSAS V.10 (1794) 125). A comparable method was employed in Buchanan twenty years later and it was apparently still in use in Aberfoyle in 1845 (Graham (1812) 216, NSAS (1845) V.10 (Perth), 1157).

The increased density of standards perhaps marked a response to higher prices for timber, especially near the
end of the eighteenth century. It might be assumed that the increased density and cutting age of standards would damage coppice. It has already been noted that standards tended to produce fewer and poorer shoots than conventional stools after being cut over, especially after more than one reservation; they also tended to suppress the underlying coppice growth (above, 7.5). Only sixteen standards more than forty-eight years old were retained in any one hagg in Menteith, however, and the overall density was low. The haggs in Menteith probably contained an average of about sixty acres (24 ha) (below, 9.5); in a hagg of sixty acres 416 standards would be distributed at an average density of 6.9 per acre (17 per hectare), in comparison to the twelve per acre (30 per hectare) required by statute in England (Hammersley (1957) 150). The harmful effects of the increased density and age of standards in Menteith may therefore have been relatively mild.

There is a certain amount of evidence of species selection in the eighteenth century; thus ash was reserved from sale under some contracts (SRO GD.220 [Wm.26]). There is no evidence that the area of coppice was extended by the planting of oak or other species until 1819, when the accounts first included payment to the forester for planting; extension had previously been carried out both in Menteith and Buchanan by alignment of the fences of newly cut haggs to include areas of oak scrub suitable for reclamation (SRO GD.220/6 (56) (1819), Graham (1812) 217).
In the eighteenth century species selection consisted primarily of the exclusion of certain woods from the regular rotation. The principal exceptions were listed in 1735, and included the woods of Culligart and Glasahole on Loch Katrine, the Forest, and an area east of it known as Lenoch; there was a small oak wood on Loch Katrine but the timber was generally birch and it was not thought at the time that these woods could be incorporated in the rotation (SR0 GD.220 [Wm.16]). The location of the Forest and Lenoch cannot be ascertained but they may have occupied the upland south of Loch Achray, where scattered woods remained until replaced recently by plantation.

Woodland on the farm of Blarinross, which occupied much of the south side of Loch Ard, also appears to have been cut outside the rotation. These woods were probably sold separately in the early 1720s; the accounts record payment for the enclosure of Blarinross in 1723 and the new enclosure there was excluded from sale when the first division was sold in 1728 (SR0 GD.220/6 (47) 291-2, [Wm.13]). In 1744 the woods of Blarinross were sold for sixteen years at a price of less than £90. Each hagg was to be enclosed for four years, and although only ash was reserved from sale the woods appear to have contained little oak; this is suggested by the low purchase price, and the oak of Blarinross was separately valued and sold in 1752 with the other woods of the first division while the contract of 1744 was still current (SR0 GD.220 [Wm.27, Wm.31, Wm.32]).
Attempts were made to manage the other woods excluded from the rotation. In 1718 the main group of unrotated barren woods was sold to an Irish merchant for ten years under a contract which seems to have been intended to restore them to good condition. The purchaser was required to cut the woods in regular hags, which were to be properly cleared and enclosed, and in order to prevent the growth of dense brushwood he was also obliged to cut all accessible living timber; it is perhaps significant, however, that he was expected to leave material only for enclosure of the oak woods (SRO GD.220 [Wm.12]). The contract was almost certainly abandoned after a few years and it is probable that some of the woods remained uncut (below, 10.5). In 1740 Glashoile contained old oak wood estimated to hold valuable timber and 800 bolls of bark, approximately the amount contained in a hagg of the rotated woods (SRO GD.220 [Wm.18]).

The Loch Katrine woods were again sold in 1750, with those of Portnellan on the north shore but without the Forest and Lenoch; during the three years of cutting the purchaser was required to dress the stool adequately and clear brushwood from the site, and the accounts show that woods on Culligart and Glashoile were enclosed after cutting (SRO GD.220/6 (49) (M1751-4), [Wm.30]). There is no further evidence about the woods until 1819, when Southey claimed that the woods of Ben Venue had been sold in the previous year; there is no entry in the accounts
to confirm this, but a hagg on Loch Katrine was sold in 1830 (SRO GD.220/6 (56), Herford, ed. (1929) 30). Attempts to restore these woods to a profitable state seem to have had little success. It was stated in 1735 that they were excluded from the rotation because they contained only a few sections of oak wood, but isolated fragments of oak in other parts of the earldom were incorporated in the rotation (SRO GD.220 [Wm.16]); the woods on Loch Katrine may have been excluded because carriage from the loch was exceptionally difficult and they were effectively less accessible than the other woods of the district.

The management of the woods of Aberfoyle and Menteith as a whole may have been neglected to some extent in favour of those of Buchanan. When the woods of both estates were divided into three parts shortly after 1700, those of Menteith were more productive; estimates for the first and second divisions of Menteith and Buchanan show that in the first cuttings the Buchanan divisions produced only forty and seventy per cent respectively of the bark available from their counterparts in Menteith (SRO GD.220 [Wm.6a, Wm.8]). In 1751 Buchanan became the main seat of the Montrose family and thereafter appears to have received more attention than the other Montrose lands. By the early nineteenth century the semi-natural coppice of Buchanan was thought to be roughly equivalent to that of Menteith in size, covering 1,800 acres (730 ha); Buchanan also had extensive plantations in which the oak was treated as coppice
The third duke was interested both in plantation and coppice management; the area of Buchanan regarded as natural wood or coppice was estimated to be 3,000 acres (1,215 ha) in 1845, shortly after his death (NSAS (1845) V.8 (Stirling), 95). This may have been an over-estimate, but it is evident that the area of coppice had increased to some extent; the annual average sale price of the coppice was then £950, whereas in Menteith the average after deduction of costs was as low as £430; in Buchanan plantation had become more valuable and provided an income of £1,300 per annum for which there was no equivalent in Menteith (NSAS (1845) V.8, 96 (Stirling) V.10 (Perth), 1160). Although secondary to those of Buchanan, the woods of Menteith remained under coppice management until the end of the nineteenth century, when Schwappach examined the oak coppices of the country between Callander and Balmaha. His route between these points is not certain, but he certainly saw the Buchanan coppices and almost certainly passed some of the woods of Menteith. He found the standard of management low. The rotation had been reduced to twenty-one years, and the shoots were too severely thinned; old exhausted stools were retained and short bushy standards suppressed the coppice (Schwappach (1898) 15). It is possible that the standard of management declined toward the end of the century.
Figure 9.11. The residences of bark merchants.
The sale of the produce

Neither Kincairdine nor the Menteith coppice was near a major market town, as is indicated by Figure 9.11. Kincairdine was approximately fourteen miles (23 km) from both Perth and Stirling; the small town of Auchterarder is unlikely to have provided a market for much of the bark and timber. The Menteith woods were less favourably placed; the hamlet of Aberfoyle was eighteen miles (29 km) linear distance from Stirling and twenty-three (37 km) from Glasgow (NSAS (1845) V.10 (Perth), 1157-8). The actual travelling distances were greater and overland transport was generally necessary, although bark could be shipped to the lower Forth from Stirling and by the late eighteenth century bark was being sent from Aberfoyle to Stirling in small boats on the Forth (OSAS V.10 (1794) 125, Fig. 9.11). Transport costs were therefore relatively important; it has already been noted that the carriage of bark from Menteith in the middle of the eighteenth century cost a sum almost equivalent to twenty-five per cent of the market price (above, 8.7).

Remoteness from major markets increased the significance of transport costs and probably also encouraged the sale of coppice to small local merchants. Before Menteith came into the possession of the Montrose family the cutting and sale of the coppice was at times undertaken by the earl of Menteith himself, and in 1760 a company of Glasgow merchants bought a full rotation of the wood. In the interven-
ing period, however, the merchants involved in the purchase of the wood were small proprietors and tenants resident in the Forth valley between Aberfoyle and Stirling, with the exception of two Irish partners who sold their interest to a local man after less than five years (SH0 GD.220/6 (30) 514); as Figure 9.11 indicates, most occupied farms approximately equidistant from the wood and the market. The purchasers of Kincardine were more markedly local; with the exception of a partnership which bought the wood in 1729 the few merchants named in connection with the wood between 1680 and 1770 were all resident within six miles (9.7 km) of the site (Fig. 9.11).

Sale was generally by auction but the commissioners appear to have been willing to negotiate privately, especially with merchants who had already proved capable of completing a contract (SH0 GD. [Wm.24, Wm.28, Wk.6]). Long-term contracts were uncommon in the sale of coppice (above, 8.5); they were employed both in Kincardine and Menteith, but under different circumstances. Until 1736 the whole wood of Kincardine was sold under each contract. Under the agreements of 1653 and 1680 the whole wood was cut over in periods of six and twelve years respectively (SH0 GD.220 [Wk.1, Wk.3, Wk.10]). When cutting was extended to form a full rotation the wood was again sold as a whole, and the first contract was entirely completed, but it was followed by two abortive contracts in 1729 and 1732 respectively (SH0 GD.220 [Wk.5, Wk.6, Wk.7]). Thereafter the wood was
sold in quarter sections and during the next thirty-seven years Andrew Carrick in Woodside and his son Robert cut it under four separate contracts, only one of which was for more than one division of the wood (SRO GD.220/6 (50) (K1759, 1764-6, [Wk.12, Wk.14]).

The memorandum of the 1690s advised that only sufficient wood for three years of cutting should be sold at one time in Menteith, unless full payment was made within the first three years (SRO GD.220 [Wm.1]). This advice became inappropriate when the woods were divided into sections most suitably cut in seven or eight years, but no more than one division was sold under any contract before 1760. This policy appears to have been founded on caution rather than experience of the unreliability of bark merchants; only two of the eight contracts between 1705 and 1759 were not completed by the original purchasers, and in both cases cutting and payment was completed by their assignees (SRO GD.220/6 (12), GD.220/6 (30), 514, GD.220 [Wm.23]). In 1757 John Muirhead, a Glasgow woodworker engaged in cutting in Buchanan, proposed to the commissioners that the adoption of long contracts in the cutting of the woods would be advantageous both to the proprietor and the merchants; his arguments have already been examined (above, 8.5).

Muirhead himself could only obtain a second eight-year cutting in 1759, but the commissioners may have been imp-
pressed by his petition; in the following year a group of Glasgow merchants identified as the Smithfield Company entered a twenty-four year contract for the three divisions of Menteith. In 1760 the Smithfield Company also acquired an interest in the Perth estate woods in Strath Gartney, and when Muirhead's contract expired the same company took a twenty-year lease of the woods of Buchanan (SRO GD.220/6 (50) (M1760), (M1758-9, 1767-8), E.721/5, 19). The account series terminated in 1771 and it cannot be certain whether or not the company completed the contracts, which were due to be finished in 1783 and 1790 respectively.

It is almost certain that no more long contracts were undertaken. As already indicated the general market price for bark rose greatly after 1790 and it became convenient for proprietors to sell individual haggs annually by auction as long as prices continued to rise (above, 8.5). The last series of surviving Montrose accounts commenced in 1814, immediately after the peak in bark prices, and continued until 1833, when the subsequent general decline in prices was evident. Individual haggs in Menteith and Buchanan were sold at very varied prices, and although the rotation was maintained in broad terms the flexibility necessary for utilisation of favourable trends in prices appears to have been preferred to strict observance of the cutting sequence. Thus in 1818 a cutting of Craiguchtie and Milton was bought for £2,030,
the highest price paid during the period, but there is no record of the sale of timber or payment for enclosure in 1819; it appears that the two haggs of these woods were sold together for cutting in a single year, and two separate haggs were sold in both of the years 1831 and 1832 (SHO GD.220/6 (56)).

The radical change in the value of coppice and the income available from it at the end of the eighteenth century is indicated by Figure 9.12, which plots the estate's gross average annual income from coppice in Kincardine over the period 1654-1772; comparable data for Menteith in the period 1705-1833 are presented in Figure 9.13. The data employed are derived largely from contracts and accounts, and include the prices paid for haggs of coppice by annual roup or sale on contract; the proceeds of the sale of planted timber, thinnings, and casual items are not included. Under some short contracts payment was completed in the first few years; in other cases the payments in the earlier years were larger than the instalments paid toward the end of the contract (SHO GD.220 [Wk.3, Wm.11]). In such cases the total payment has been distributed to indicate the average annual income over the whole contract. Under the contracts of 1653 and 1680 the whole wood of Kincardine was cut and paid for in periods far shorter than the cutting interval; the average incomes for the full interval between sales are shown rather than those for the short period of cutting (Fig.9.12, Fig.9.13).
INCOME REPRESENTS THE ANNUAL PAYMENT TO THE ESTATE UNDER COPPICE CONTRACTS, BEFORE DEDUCTION OF COSTS, AVERAGED OVER THE PERIOD OF EACH CONTRACT (See text, section 9.4).

COSTS ARE THOSE STATED AS BEING INCURRED DIRECTLY BY THE ESTATE IN THE MANAGEMENT OF COPPICE (See text, section 9.4). WHERE INFORMATION IS AVAILABLE, A SECTION AT THE BASE OF THE COLUMN REPRESENTING INCOME IN THE APPROPRIATE YEAR IS LEFT BLANK, EQUIVALENT TO THE LEVEL OF COSTS IN THAT YEAR.

\( p \) — PROJECTION OF THE INCOME LEVEL TO THE TERMINAL DATE OF A CONTRACT, IN THE ABSENCE OF ACCOUNTS FOR THE PERIOD IN QUESTION.

Based on SRO GD.220/6(46), GD.220/6(47), GD.220/6(49), GD.220/6(50), [Wk.1, Wk.3, Wk.5, Wk.6, Wk.7, Wk.12, Wk.14].

Figure 9.12. Income from coppice in Kincardine, 1654-1772.
Based on SRO GD.220/6(46), GD.220/6(47), GD.220/6(49), GD.220/6(50), GD.220/6(56), [Wm.7, Wm.9, Wm.11, Wm.13, Wm.17, Wm.25, Wm.29, Wm.30]

Figure 9.13. Income from coppice in Menteith, 1705-1833.
Certain factors must be taken into account in the interpretation of these diagrams. Firstly, the price paid for wood was agreed before cutting commenced; the average annual income during any contract therefore reflected conditions at the time of sale, and although sale prices may at times have anticipated continuation of trends in prices there was no mechanism for revision of prices during a contract. Minor price changes are therefore disguised and it is possible that in some cases major changes took place during the currency of the longer contracts. Secondly, annual cuttings were not always exactly equivalent in size. Fluctuations in price in the eighteenth century may in part have resulted from differences between divisions and those after 1814 from differences between haggs; it is also possible that the yield of divisions or haggs changed from one cutting to the next. Finally, the rotation of Kincardine increased from twenty-four to thirty or more years in 1736 and that of Menteith from twenty-one to twenty-four in 1735; as new woods were not brought into the rotation the average size of haggs must have decreased, but reduction in size would be offset to some extent by the increase in yield possible when the cutting interval increased.

Figure 9.12 indicates that the income from Kincardine rose slowly in steps until 1729; there was then a marked rise during the two unsuccessful contracts, which may indicate an over-optimistic response to a general increase in
prices after twenty-four years of controlled low annual payments. In 1736 the annual income fell to less than £112 per annum and remained approximately constant until 1766, when it rose from £106 to £118 per annum; the income at that time was therefore forty per cent higher than in 1705 but only seventy per cent of that of 1729 (Fig. 9.12). During the period 1705-43 the income sequence in Menteith was not dissimilar. Figure 9.13 shows that the income available from the woods increased greatly after 1718, which suggests a substantial price increase after 1710, and the level rose again in 1728. The price paid for the next division was identical, but as it was to be cut in eight years the purchaser could expect a rather higher yield and the price actually represents a small reduction; distribution of the sum over eight rather than seven years also reduced the annual income level (Figure 9.13).

There was a remarkable fall in income during the second cutting of the third division between 1744 and 1751, but after a recovery the income level remained steady at a level comparable to that of the period 1718-35 until 1771 and probably until 1783. This was equivalent to a rise of 140 per cent since 1705, but less than two per cent since the period 1728-34 (Fig. 9.13). The fall in income during 1744-51 may be attributed in part to the small size of the third division, but this had not been evident when the division was sold in 1718. Prices were generally low in the early 1740s; the purchaser of the previous division had
failed and the uncut hagg was sold at a low price (SRO GD. 220 [Wm.23]). As prices were low and merchants scarce the duke wished to sell only one half of the third divisionion in 1744, and this in itself may have reduced the price which merchants were willing to pay. The commissioners' valuation of the wood was questioned by the first merchant to show interest in the division, and this may have had a further effect on the price obtained in 1744, but that of 1748 was little better (SRO GD.220 [Wm.24], Fig.9.13).

Although the produce of both woods apparently went mainly to the same market there is little initial resemblance between the income trends of the two woods in the eighteenth century. Some features, such as the stability of prices after 1750, are common to both, but the pattern in Kincardine resembles the general sequence suggested earlier less than does that of Menteith (above, 8.3). There was a relatively steady trend in Kincardine except during the period 1729-35, and the rapid failure of the two contracts involved then suggests that the price increases were unrealistic. The larger quantities available from Menteith would be proportionately more profitable when demand was keen, but merchants were committed to the cutting of equal quantities in each year; anticipation of difficulty in selling large quantities when demand was low may have depressed the sale price of the Menteith woods when markets were doubtful. Kincardine was proportionately
more profitable than Menteith, although apparently no more than twenty-five per cent of the size of the Menteith coppices; Kincardine provided almost as high an income in the early eighteenth century, and in 1770 the annual value was still more than half that of Menteith (Fig. 9.12, Fig. 9.13). The accessibility and compact nature of the wood may have reduced the cost of cutting and carrying the produce.

Figure 9.13 illustrates the striking change in coppice values between the third quarter of the eighteenth century and the first half of the nineteenth. Even the lowest price obtained for a single hagg in the period 1814-33 was more than double the highest average income before 1783, and the average annual income over the twenty-year period from 1814 was slightly more than £1,000, more than four times the highest previous average (SRO GD.220/6 (56)). There was very considerable short-term fluctuation. The national peak in prices immediately preceded 1814, and in Menteith appears to have been followed by a brief depression and then a secondary peak in the early 1820s; the subsequent decline is rather obscured by the high income levels of 1831 and 1832, years in which two haggs were sold (SRO GD.220/6 (56), Fig. 9.13).

The proportion of revenue from the sale of coppice remaining after costs were met appears to have been considerable; Figures 9.12 and 9.13 incorporate the costs of coppice management in the woods during periods when these
were recorded in accounts which survive at present. These exclude all the costs incurred in the cutting and disposal of the produce, which were met by the purchaser. In the case of Menteith the major stated costs were the forester’s salary and payment to tenants for enclosing cut haggs; after 1752 a certain amount was paid to the merchant cutting the wood in compensation for timber provided under the terms of the contract for the repair of tenant houses. After 1759 this was restricted to the houses of the barony of Port and the level of compensation fell noticeably. When the post of forester was discontinued in 1753 the main stated cost in Kincardine was that of enclosure. In Menteith the stated costs were noticeably higher than ten per cent of annual income only in the period 1752–9, when the use of timber for tenant houses raised the cost level as high as eighteen per cent (Fig. 9.13). In Kincardine costs were as high as fifty-five per cent in 1703; this and other relatively high cost levels before 1723 resulted from the building of an outer stone wall. Costs were later approximately ten per cent of income until 1753 and thereafter considerably less (Fig. 9.12).

Operating costs were proportionately higher in Menteith after 1814, when more attention was paid to the improvement of coppice. Stated costs then included the forester’s salary, the costs of thinning, preparation of thinning bark, drainage and planting, and payment for enclosure. An additional profit was also available but cannot be det-
ermined from the accounts. The sale of thinning bark probably provided the largest additional income, but only in three years was the value of the thinning bark of Mentheith specified; it was equivalent in each case to between twenty and thirty-five per cent of operating costs (SHU GD.220/6 (56) (1830-3). Figure 9.13 therefore indicates the relation between total operating costs and the largest item in the income from coppice, the annual sale of haggs of oak. Costs were higher than in the previous century; although the average income was slightly over £1,000 per annum costs were now higher than ten per cent, falling below £100 only twice in years when haggs were cut. As the price of bark declined there was a relative and absolute rise in management costs; costs amounted to as little as five per cent of income in 1820 but rose to be equivalent to forty-three per cent in 1833. The costs in that year were higher than the greatest average annual income before 1783 (Fig.9.13).

The apparent income after costs declined as the nineteenth century advanced. The residue after stated costs was more than £1,900 in 1818 and probably higher in the years before 1814, but had fallen to less than £400 by 1833 (Fig.9.13). In the early 1840s the average residue after costs was said to be £430. There is no evidence that the value of coppice produce rose overall in the intervening period, and it is possible that the increased margin was achieved only by reduction in the cost of maintenance;
this would almost certainly be accompanied by a decline in the standard of management (NSAS (1845) V.10 (Perth) 1160). Other costs are likely to have reduced the profitability of operations but there is no evidence relating these directly to the management of woodland. Such indirect costs probably included land tax and other taxes on the estate in general, the loss of interest on capital used in improvement, and a proportion of the routine costs of estate administration. It is probably also necessary to take into account a reduction in the general grazing rent. No abatement was given and farm rents may have been calculated in Menteith to allow for the periodic loss of grazing land. Kincardine was partly on cultivable land and parts might more profitably have been tilled, but the Menteith woods were mainly on marginal sites which in the south-west Highlands continued to be most profitable under coppice for some time after 1800 (Whyte & Macfarlan (1811) 156, Graham (1812) 213).

Little information is available about the affairs of the merchants who bought coppice in the Montrose woods except purchase prices; it is therefore not possible to assess the relationship between the nett income of the proprietor and that of the merchant. It has already been noted that in 1743 a low estimate of the market value of the known yield of bark in the third division was used as the basis for the proprietor's asking price; the purchaser was expected to cover costs and make some profit from the sale
of timber and bounty bark (above, 8.4). This suggests that merchants could expect only a slender profit margin. This is also indirectly indicated by the stable status of the small part-time merchants who cut the Montrose coppices during most of the period; thus Andrew and Robert Carrick cut the Wood of Kincardine for at least thirty-seven years without evident change in their status or prosperity. The purchase of coppice may have been seen in such a case primarily as a means of augmenting the less predictable income available from tenant farming.

Some information is available about the costs met by the merchant. Two estimates made about 1743 indicate that the costs of preparing and carrying a stone of bark together amounted to thirty-seven per cent of the price which could be expected per stone; carriage alone cost between twenty and twenty-two per cent (SRO GD.220 [Wm.24, Wm.25]). The cost of carriage was much higher in proportion than the average in Scotland as a whole rather later, and indicates the difficulty of marketing the produce of Menteith (above, 8.7).

It has been noted that the sale of timber was crucial to the success of trade in coppice produce. Kincardine, adjacent to a small town and on the margin of a densely populated rural area, was better placed for the disposal of timber than the woods of Aberfoyle. These had a less satisfactory rural market and no town of any size was closer than those to which the bark was sent; even after 1790
the timber of the Menteith woods was insufficient in value to meet the costs of preparing bark (OSAS V.10 (1794) 125). The purchaser was in each case entitled to sell all standards except the few selected for a second or third reservation; under the contracts which obliged the merchant to provide timber for buildings in Menteith it was specified that the wood should come from the coppice growth rather than the standards (SRO GD.220 [Wm.26, Wm.29, Wm.32]).

It is very likely that the timber of Menteith became proportionately more profitable in the late eighteenth century, when the density of standards increased and there was a national rise in timber prices; it is also likely that the purchasers of the woods were still unable to make extensive use of any market except that of the adjacent rural area. The estate sawmill installed in 1825 was in a position more suited to the utilisation of the small timber of Buchanan and the pyroligneous acid plant installed at Balmaha by 1845 was also designed to use the produce of Buchanan, although a portable distillation plant was in use near Aberfoyle in 1821 (Atkinson (1821) 19, NSAS (1845) V.8 (Stirling), 96). The diversification and extension of the uses of coppice timber in the nineteenth century probably had much more effect on the value of Buchanan than on the Menteith woods (above, 8.4); the purchasers of Menteith were therefore able to make little use of timber to offset the decline in the price of bark in the later part of the century.
It has been noted that carriage from the Menteith woods was expensive. The services of tenants were made available to purchasers both in Kincardine and Menteith for the carriage of bark in the earlier part of the period and continued to be used in Kincardine under all the surviving contracts (above, 8.7). In 1653 carriages of fourteen Scots miles (c. 25 km) were granted, and although the distance was reduced to twelve Scots miles (c. 22 km) in 1680 it was still sufficient to reach Stirling and Alloa (SRO GD.220 [Wk.1, Wk.2]). Later the carriages were granted subject to the conditions of the feu contracts of the barony; these were not defined in the contracts of sale, and it is not therefore certain that the same destinations were employed (SRO GD.220 [Wk.5, Wk.6, Wk.7, Wk.12, Wk.14]). Stirling and the shipping point of Manor Neuk were apparently the main destinations of carriages from Menteith, although one contract also named Glasgow (SRO GD.220 [Wm.7, Wm.10, Wm.13]).

As already noted carriages were not granted in Menteith regularly after 1735, despite the distance of the woods from markets and the continued use of carriages from less remote woods later in the century; it is possible that water transport on the Forth was introduced early enough to make carriages unnecessary by this date (above, 8.7, OSAS V.10 (1794) 125). The Smithfield Company may have sent bark to Glasgow during the rotation which started in 1760, but the marketing of Menteith produce appears to
have centred on Stirling. Menteith was therefore probably little affected by the expansion of the Glasgow bark market and the development of a wide range of commercial uses of coppice timber in the Glasgow district; the Smithfield Company sent charcoal from Strathart Gartney to Glasgow, however, and coals may also have been carried from Menteith (SRO E.721/5, 19).

9.5 Effects on the quantity and quality of woodland

There is relatively little evidence of change in the dimensions of the woods of Kincardine and Menteith. The Wood of Kincardine was sketched as a block at the junction of the Ruthven and the Lochy Burn in two of the manuscript maps in the National Library of Scotland attributed by Cash to Timothy Pont; these maps may date from the late sixteenth century and suggest that the wood was not then significantly larger than later in the period (NLS (M) EMS.b.4.3, 21, 22, Cash (1907) 580-1, Stone (1970) 16). Adair's manuscript map of Strathearn represents the wood in a form very similar to that of the present; the map was probably produced about 1685 (NLS(M), Case 8A.2, 2). The representation of the district in the Military Survey was exceptionally poor, but Stobie's county map of 1783 indicates that the wood was by that date essentially identical in outline to the present form (M.S. (1747-55m) 17/4, Stobie (1783m)). One major change appears to have taken place by then; the Pont and Adair maps placed the
PROBABLY CLEARED 1685-1783.
CLEARED 1783-1866.
REMAINING IN 1866.

1. Castle.
2. Castle, in ruins.

Based on various sources; see text.

Figure 9.14. Change in the area of the Wood of Kincardine.
castle within the wood but Stobie's map and later surveys indicate that the ruins lay outside the Broad Wood.

There was still planted timber round the castle in 1732, but it is possible that the area immediately adjacent to the southwest boundary of the surviving Broad Wood and including the castle was covered by coppice until the eighteenth century (SRO GD.220 [Wk.7]). Minor changes took place between 1783 and the production of the first Ordnance Survey maps of the district in 1866 at a scale of 1/10, 560. The strip of wood north of the Lochy Burn was largely cleared and two fields created by clearance immediately south of the Burn (OS 6" P.118 (1866m)). The construction of a railway through the Broad Wood about 1848 caused no major changes (O'Dell & Walton (1962) 206).

Transfer of the pattern to a modern base map permits measurement by a simple unit square method; the quality of the data does not allow the use of more accurate methods of measurement. Figure 9.14 marks the wood as it existed in 1866 and illustrates the probable sequence of earlier clearances; there has been no substantial change in the area of the wood since that date. If the wood was once large enough to contain the castle it may have been as much as 450 acres (182 ha) in extent, but when surveyed by Stobie in the late eighteenth century it was probably slightly less than 400 acres (162 ha) in area; it could therefore have been divided into thirty-two haggs with an average
size of 12.5 acres (5.1 ha). By 1866 the area of the wood had been reduced to approximately 340 acres (138 ha) (Fig. 9.14).

Map coverage of Menteith is less adequate and the earliest surviving large-scale map is that of the Military Survey; the pattern of woodland marked by the survey is reproduced in Figure 9.15. Later cover was provided by Stobie's county map of 1783. Figure 9.16 is based on the pattern of woodland shown by Stobie; as his map did not include the Stirlingshire barony of Drummond the few woods in the barony are shown as they were marked by Grassom in his later map, the nearest in date to Stobie's survey (Fig. 9.16). Figure 9.17 is derived from the first Ordnance Survey maps of the district, published in the period 1863-6; comparison of the pattern of woodland marked by these surveys indicates that little quantitative change took place in the area of the Menteith woods between 1750 and 1865 (Fig.9.15, Fig.9.16, Fig.9.17).

The quality of work in the appropriate sheets of the Military Survey was generally high but rather variable; some areas such as the south side of Loch Ard were poorly surveyed and others, like the upland round Loch Drunkie, appear to have been given no more than a cursory examination (M.S. (1747-55m) 15/3, 15/4). The survey is not totally reliable and certain large woods were omitted which are known to have existed at the time. The marked locations of
Figure 9.15. Woodland in Menteith, 1750.
Figure 9.16. Woodland in Menteith, 1783.
Figure 9.17. Woodland in Menteith, c.1865.
wood were in general very similar to those of the later surveys but they were represented as a continuous pattern rather than fragments; this may result from the use of different methods of survey and drafting, and the discrepancy between this and the later surveys is small enough to be explained largely by technical differences in map production. The reduction of greatest apparent significance between 1750 and 1783 was on the northern shore of Loch Ard; comparison with the estimate of yield made in 1752 suggests that if the Military Survey was in fact correct in showing such an area of woodland little of it can have been oak (Fig. 9.8, Fig. 9.15, Fig. 9.16).

There is a strong resemblance between the pattern drafted by Stobie in 1783 and that of the first Ordnance Survey maps eighty years later, when the coppice regime was in its final phase. Stobie's pattern of woodland was quite clearly not based on accurate survey, but corresponded very closely to the later survey in showing the location of woodland (Fig. 9.16, Fig. 9.17). Comparison with Figures 9.6 and 9.7 shows a marked similarity in location between the woods earlier cut as coppice and those shown as compact woodland in 1863 (Fig. 9.6, Fig. 9.7, Fig. 9.17). On the whole cartographic evidence suggests that there was little change in the area of woodland in the district in the period after 1750; the increase in the yield of the divisions in the first half of the century suggests that there was no real deterioration after 1700 (above, 9.3).
Improvement of the woods appears mainly to have taken the form of consolidation within existing coppice and the inclusion of adjacent areas of scrub woodland; it is not therefore likely to have led to a major change in the apparent area under coppice (above, 9.3).

Measurement of the area of woodland marked by the Ordnance Survey about 1865 suggests that by the third quarter of the nineteenth century compact woodland covered approximately 1,350 acres (547 ha) in Menteith. Measurement from earlier surveys is not in this case practicable, but if it is assumed that the compact woodland of the 1860s corresponded to that cut earlier in rotation the haggs must on average have been about 56 acres (23 ha) in size; according to Graham those of Buchanan were between seventy and one hundred acres (28-41 ha) each in the early nineteenth century (Graham (1812) 214). In the 1860s open woodland covered rather more than 900 acres (365 ha), bringing the total to approximately 2,250 acres (911 ha); some of this may earlier have been coppiced; in 1812 Graham estimated that approximately 1,800 acres (730 ha) of coppice were managed in Menteith (Graham (1812) 214). Most of the woodland was in Aberfoyle parish, where it covered slightly more than eight per cent of the land surface in the 1860s; after extensive Forestry Commission planting woodland covers approximately thirty-two per cent of the surface of the parish (Fig. 9.17).
There is some documentary evidence of the decline of woods in Menteith. The order for the cutting of Glassert and Milton has already been examined but there is no reason to believe that it was carried out (above, 9.3). A number of independent reports suggest that the woods on Loch Katrine, which were not in the rotation, decreased in area in the late eighteenth and early nineteenth centuries. It has already been noted that the ten-year contract for the cutting of these woods after 1718 was not completed; when they were cut in 1751-3 some of the oak trees may not have been cut for fifty years or more (above, 9.3). This may provide a basis for the account given by Graham in 1812, according to which the York Buildings Company had bought the woods sixty years previously and failed to cut them; when the commissioners were finally able to surmount legal obstacles and proceed with cutting the woods were over forty years old and failed to regenerate (Graham (1812) 217). This report was undoubtedly inaccurate but a similar account was published in the early nineteenth century concerning a small old coppice on Loch Katrine owned by another proprietor, and a number of contradictory reports about the Montrose woods on the loch appeared after 1800 (Oswald (1811) 26).

Dorothy Wordsworth observed in 1803 that Ben Venue was covered to a great height by birch woods, but in 1819 Southey denounced the third duke for selling the timber of Ben Venue for a paltry sum in the previous year, leaving
only the smaller and less valuable trees (Shairp, ed. (1874) 99, Herford, ed. (1929) 30). MacCulloch admired the woods of oak and birch on the sides of Ben Venue in 1824, however, and the estate accounts indicate that the woods of Loch Katrine were not cut until 1830, which suggests that the previous cutting had been well before Southey's visit (SR0 GD.220/6 (56) (1830), MacCulloch (1824) V.1, 171-5). In 1834 travellers again complained about the cutting of large amounts of fine timber on Ben Venue in previous years (Anderson & Anderson (1834) 423). The maps suggest that the allegations of mal-treatment were not totally unjustified; although the first Ordnance Survey maps resembled the earlier surveys in showing that wood survived at the southeast end of the shore on Loch Katrine on the lower slopes of Ben Venue, it appears by then to have been very open and scattered (Fig. 9.15, Fig. 9.16, Fig. 9.17). No precise information is available about the period and cause of the decline of this wood.

Little direct evidence survives of a type which might indicate change in the quality of the woods during the period. It may be said with some confidence, however, that the tendencies toward species segregation and selective protection of oak which appear to have been general in oak tanbark coppice management applied in the case of the Montrose woods (above, 8.6). Areas in Menteith dominated by barren timber were excluded from the managed rotation of oakwood as early as the beginning of the eighteenth cen-
tury, although selective planting of the favoured species and other forms of positive segregation do not appear to have been regularly employed for another century. The wood of Kincardine was probably subject to a gradual process of species selection through its history; by the middle of the eighteenth century the Broad Wood was apparently richer in oak than the Glen, which contained a variety of sites more suitable for other species.

The coppices of the Montrose lands have already been selected as notable examples of Scottish coppice management; thus Edlin took them to have been among the few areas of properly and regularly-managed coppice in the country (Edlin (1956) 104-5). There is no reason to doubt that the Montrose woods were better and more regularly managed than most other areas of coppice in Scotland and for a longer time. Comparison of the preceding examination of the form of management in the Montrose lands with the principles of coppice operation understood in Scotland as a whole, however, indicates that even on those lands the level of management was not always entirely satisfactory (above, 7.5, 9.2, 9.3).

The detailed provisions of the contract for the sale of Kincardine Wood in 1680 give a remarkable indication of the early adoption of principles which were not generally adopted until considerably later, but the management of Kincardine and Menteith was not always enlightened (SRO GD.220 [Wk.3]). In Kincardine management difficulties
appear to have arisen from the inertia of traditional methods and the relatively high value of the site for other land uses; in Menteith concessions were made both to other land uses and to commercial demands. Thus there is no evidence that more than six years of protection from grazing were given in Menteith at any time, although this was thought inadequate in general and as many as ten years were allowed in Kincardine (above, 7.5). Similarly, the number of standards reserved at each cutting in Menteith rose greatly during the eighteenth century, and in the framing of contracts more reliance was placed on mutual understanding of rights and duties than may have been advisable. In general terms the management of both woods appears to have been seen largely as the conservation of existing resources during the eighteenth century; such a form of control was not adequate to counteract the inevitable processes of wastage, no matter how efficiently it was applied.

Only when the profitability of coppice operations increased greatly in the late eighteenth century was management extended to include regular improvement of the coppice stock. As already suggested, this phase of improvement may have ended in Menteith before 1850, but Schwappach's evidence indicates that the woods were still regularly managed at the end of the century (above, 9.4, Schwappach (1898) 15). The decline in the price of bark made it necessary to cut management costs if the sale of coppice
was to remain profitable, and this could most easily be achieved by reducing the intensity of supervision and the quality of management; unlike those of Buchanan the coppices of Menteith fell within the zone of coppice marketing centred on Stirling, and few commercial markets were available for coppice timber (above, 8.8). Despite the deficiencies which persisted throughout the period, however, the rotational cutting of the Montrose woods appears to have succeeded in preserving the deciduous woods of Menteith and Kincardine in a relatively stable form.

Sections of the wood of Kincardine appear to have been cleared for agriculture at different times, but it is still recognisably the wood which existed three centuries ago. In Menteith woods were protected against grazing for short periods but enclosure was regularly applied and maintained, and there was also a marked regularity in the period of the cutting cycle over more than a century after 1705. Evidence of the decline of woodland in Menteith before 1865 relates only to the woods which were excluded from rotational cutting and protection. It therefore appears that a form of coppice management which ensured that young growth was regularly protected and haggs regularly cut was sufficient to permit the survival of coppiced wood.

Other aspects of management undoubtedly improved the yield and quality of woodland and some measures were necessary to counteract natural wastage, but the example of the Menteith and Kincardine woods suggests that these may be
regarded to some extent as refinements rather than necessities. It is nevertheless possible that these aspects of management had significant effects on the quality of woodland and its ability to survive after the abandonment of coppicing. Thus it has already been noted that the status of oak in the Highlands is marginal, and that coppice management in Scotland tended to create pure stands of oak (above, 4.8, 7.6); it is therefore possible that when the temporary protection of coppice management was withdrawn woodland was more vulnerable to non-commercial pressure than previously.

Selective protection and planting of oak has had a marked effect on the woods of Buchanan, the management of which was very similar in a number of ways to the form employed in those of Menteith (Tittensor (1970) 110-15); Tittensor found that evidence of species selection during the period of management was in fact the main indication of human modification of the woods (Tittensor (1969) 140, Tittensor (1970) 108). Although Tittensor did not attempt to trace changes in the extent of the woods of Buchanan, it is evident that in this case at least selectivity has not led to the rapid decline of oakwood; those of Buchanan are among the few surviving semi-natural oakwoods of reasonable quality in Scotland (McVean (1964a) 155). This may be attributed in part to the quality and regularity of the system of management common to the Menteith and Buchanan woods, and also partly to the continuation of management
and protection until the end of the nineteenth century. The woods of Menteith are not recognised as being among the better surviving oakwoods, and it is possible that when the value of oak coppice declined management was concentrated on the more accessible woods of Buchanan, but the incorporation of the remnants of the deciduous woods of Menteith within extensive coniferous plantations makes assessment of the present extent and quality of the deciduous woods difficult.

9.6 Summary

The small Wood of Kincardine was cut as coppice by the Montrose family between 1650 and 1770; the woods of the earldom of Menteith were cut as coppice by the late seventeenth century and continued thus to be cut until the end of the nineteenth century.

Markedly different forms of management were employed in the two woods; this may be explained largely in terms of tradition, size and form, and the effects of location. In neither case was management comparable with the highest standards understood in Scotland at the time, but in both cases regular rotational cutting and periodic enclosure took place. After 1800 the quality of management in Menteith improved greatly, apparently in response to an increase in the value of coppice produce.

Neither wood was close to markets for bark and timber,
and this restricted the value of the coppice; small local merchants cut coppice on contracts of varying length and sold the produce mainly to Stirling and the upper Forth. In the eighteenth century the residue left to the proprietor after costs was about ninety per cent of the purchase price, and the merchants appear to have had very small profit margins. In the nineteenth century individual haggs of coppice were sold; in the early part of the century the income available to the proprietor rose greatly in absolute terms but costs also rose considerably.

Parts of the Wood of Kincardine were cleared for cultivation but the area of the wood changed little over the period. The only clear evidence of decline in Menteith is associated with birchwoods excluded from rotational management. Management of the Montrose woods was not entirely satisfactory but the survival of coppice through the period appears to have been ensured by regular cutting and brief but regular enclosure of cut stools.
10.1 Introduction

The production of iron with charcoal has been selected by some authors as an especially widespread and damaging use of Highland woodland. It is frequently assumed that the legal restrictions imposed on the use of timber for smelting in England in the late sixteenth century led English ironmasters to explore the more remote wooded areas of Britain, and that the use of Scottish timber by such exploiters, already regular, accelerated after the pacification of the Highlands in 1745. Ideas of this kind have been the basis for general condemnations of the role of ironwork in the Highlands. Thus in 1913 a descendant of a family closely connected with the foundation of the first Scottish coke-smelting plant at Carron briefly examined the history of charcoal smelting in the Highlands and commented: 'So much charcoal was used that the wood supply was the prime factor to be considered, and the ancient iron smelters are probably largely to blame for the wholesale destruction of the old Caledonian forests' (Cadell (1913) 150).

It is not difficult to find more recent expressions of similar views (Darling (1949) 133, O'Dell & Walton
As no satisfactory account of the form and development of smelting in the Highlands has yet been published and manuscript evidence remains exceptionally fragmented such statements may be regarded as premature; it is also unfortunately evident that condemnation of iron working is not infrequently expressed in terms which suggest limited understanding of the processes involved and the scale of operations. It is therefore of some value to outline the direct and indirect processes, the two basic forms of iron production, and to examine carefully the evidence available concerning the application of these processes in the Highlands.

Lead smelting, although practised in the Highlands and superficially akin to iron smelting, is not examined here. Structural timber was required in lead mining but the smelting methods employed in Scotland after 1690 allowed lead to be produced with peat and mineral coal more cheaply than with wood charcoal. Lead mining was carried out as a commercial operation in the Highlands only after this date, and there is evidence that peat and mineral coal were in fact the fuels generally employed (Smout (1967) 105, 109, Geikie, ed. (1907) V.2, 152-4).

10.1 Methods of iron production

In the direct process ore is heated with a charge of fuel to a temperature of about 1150°C. At this temperature the ore is reduced but the iron remains solid; most of
the slag component liquefies and separates, leaving the iron as a porous crystalline mass within the furnace. In the traditional working method this mass or 'bloom' was removed and hammered while still hot or after reheating, to consolidate the metal and expel any liquid slag remaining within the mass; the resulting lump of low-carbon malleable iron was then suitable for shaping and smithy work (Tylecote (1962) 183-91, Rees (1968) V.1, 175-91). The process was therefore a means of producing solid iron at low temperatures and was necessarily discontinuous. It required little equipment and was relatively simple; it was therefore widely employed in primitive iron work and was the basic method used in Europe until the mid-fifteenth century (Wertime (1962) 57).

The simplest direct-process forge or 'bloomery', a term in British usage derived from the nature of the iron produced, consisted of a low stone or clay hearth a few feet wide containing a clay-lined hollow; charcoal was ignited in the hollow of this bowl furnace and covered by layers of ore and fuel. The process was then allowed to continue for some hours until it was judged that the bloom had formed (Rees (1968) V.1, 175). Natural draught may have been utilised on exposed upland sites, but there is evidence of the use of bellows, with tuyeres to guide the blast within the charge, on Scottish sites as early as the iron age (Rees (1968) V.1, 175), Schubert (1957) 23-6). Raw timber was not a satisfactory fuel and wood charcoal
was generally employed, although there is evidence of the use of peat charcoal (Tylecote (1962) 190, 198, 264, Schubert (1957) 18). Most ores were usable but the inefficiency of the process made high-grade ores desirable for commercial operation (Schubert (1957) 15-16, Rees (1968) V.1, 179). In Scotland limonitic bog ore was used; this ore, found as a precipitated deposit under large areas of heathland turf, was open, porous, and suitable for primitive smelting (Tylecote (1962) 179, Schubert (1957) 16-17).

During the Roman occupation tapping of the furnace to remove semi-liquid slag became common and the shaft-furnace with raised walls was introduced to Britain; this innovation made use of induced draught to supplement bellows and reduced the difficulty of heating and aerating the charge evenly and thoroughly. Unlike the bowl-furnace the shaft-furnace had a structure which had to be partly dismantled and repaired every time a bloom was extracted (Tylecote (1962) 189). There were no further radical technical changes in British bloomery operation, although water-power was introduced in the mediaeval period to provide blast and was later used to power the forge-hammers used to consolidate blooms; in the more remote areas primitive bowl-furnaces remained in use to meet local demands (Rees (1968) V.1, 177, Schubert (1957) 133-4, 147, 152-3).

The main change in commercial iron production was in the scale of operation. The largest British prehistoric
blooms discovered weigh less than ten pounds (4.5 kg) and those of the Roman period appear to have been about fifteen (6.7 kg), but some mediaeval blooms weighed almost 200 pounds (90 kg) and by the seventeenth century large works were producing blooms of about 270 pounds (121 kg) (Schubert (1957) 33, 129, 147, Tylecote (1962) 232). By that time the advantages of the indirect process were apparent. Bloomeries could not be operated continuously and the structure had to be disturbed to extricate the bloom; the process was inflexible and not easily controlled during operation. In relation to the yield of iron fuel requirements were generally higher than in the indirect process, and the iron yield itself was low; in primitive work fifty per cent or more of the iron content of the ore remained in the slag, and even the slags of the later commercial bloomeries were rich enough to be recycled through indirect-process furnaces (Schubert (1957) 25-6, 232-4). Consequently, only high-grade ores produced an acceptable quantity of iron.

Another important factor was that the direct process had almost reached its technical limit. It was vital to the process that the temperature within the charge should be kept low enough to maintain iron in a solid state; the melting point of pure iron is 1535°C and the metal will melt at lower temperatures if prolonged contact between ore and fuel allows the iron to adsorb carbon: larger and taller furnaces were necessary to strengthen blast and
increase production, but it was difficult to design and operate these in such a way that the temperature was maintained at a safe level throughout the charge (Rees (1968) V.1, 177, Wertime (1962) 44-50). Changes in the market for iron were also important; in the sixteenth century casting was found preferable to the use of wrought iron in the manufacture of guns, cannon-balls, and shot, and the market for castings continued to expand (Schubert (1957) 161-5).

The direct process had certain advantages, however, especially as a means of limited production for a small local market. Operation for a few weeks in the year might be sufficient to meet demand and a small bloomery could be established or revived quickly and with little outlay. In dealing with local requirements the direct process could readily utilise low-grade impure ores like bog ore and poor fuels like peat charcoal, both of which could also be used in indirect operation but were not found satisfactory (Fell (1908) 233). Most important, the direct process produced malleable iron of high quality suitable for forging by local smiths without modification; blooms were uneven in quality and frequently contained fragments of slag or unconsumed fuel, but the low working temperature ensured that chemical impurities were negligible (Schubert (1957) 152-3, Tylecote (1962) 191, Rees (1968) V.1, 179).

The indirect process, as its name indicates, does not produce iron immediately suitable for forge work.
The furnace yields a highly carburised liquid iron which is run off and cast; the castings from the furnace may be intended as finished products in themselves or may consist of blocks or 'pigs' of iron. These pigs may then be refined and decarburised in a finery to produce malleable iron (Schubert (1957) 157-8). The term 'blast furnace', although commonly used in association with this process, is not entirely satisfactory; a blast furnace is basically a furnace tall enough to produce fluid crude iron under its own draught, but 'blast furnaces' have almost always been equipped with additional mechanisms to ensure continuous draught and reduce the height necessary for operation (Wertime (1962) 44-57).

Significant technical advances were associated with the introduction of this process. As liquid iron is required the size of the furnace is not limited by the necessity of restricting the operating temperature. The iron and slag are liquids of different densities which may be drawn off separately near the base of the furnace without termination of operations or alteration to the structure. It is therefore possible to maintain continuous operation by loading the charge at the furnace head; the main constraints on continuity of blast are the limitations of the fuel supply and deterioration in the furnace lining (Schubert (1957) 157-8, Rees (1968) V.1, 179).

Early blast-furnace operation proved more efficient than the direct process in a number of ways. The increased
scale of operations permitted an early furnace to produce seven times as much iron as a large contemporary bloomery over a twenty-four hour period, and this advantage was augmented by continuous operation over longer periods; in the early history of the process in England furnaces operated for several weeks and by the eighteenth century furnaces remained in blast for periods of six months or more. The yield per unit of fuel was also generally better and the ore was more efficiently processed; it was therefore possible to utilise inferior ores and bloomery or forge slag as well as high-grade ores (Rees (1968) V.1, 179, Schubert (1957) 161, 232-4). The production of pig allowed the stages of the process to be dispersed, as was often necessary. In the early period a plant consisted of a furnace, chafery or reheating hearth, finery and power hammer; all required water-power and the cumulative demand was higher than the head of water at one point on a small stream might allow (Schubert (1957) 158).

There were, however, several restrictions in comparison to bloomery working. High-temperature operation increased the risk of contamination by chemical impurities and certain ores could not easily be employed; bog iron ore contains an unacceptably high level of phosphorus, which tends to make iron 'cold-short' or brittle when cold (Schubert (1957) 152). The range of fuels was restricted and only wood charcoal produced an acceptable iron until the advent of coke-smelting (Fell (1908) 233). Finally,
the indirect process was not suited to production for small local markets; it required a considerably higher initial outlay than a bloomery and the plant was not designed for intermittent use. A furnace left out of blast and unsupervised for a period of one or two years was liable to deteriorate severely (Schubert (1957) 152-3, 232-4).

Acceptance of the new process was not uniform and bloomery methods were retained relatively late in some areas. The old iron-working districts of north-west England were not affected until the end of the seventeenth century, when blast furnaces were built at Holme Chapel in east Lancashire and Cleator in Cumberland (Awty (1957) 90, Schubert (1957) 191-2). In Furness, later the source of the more important charcoal-smelting enterprises in Scotland, bloomery forge operation in fact revived in the early seventeenth century and there is some evidence of construction as late as 1685; bloomery work continued at least until the building of the first local blast-furnace at Backbarrow in 1711 (Fell (1908) 191-206).

10.3 The direct process in the Highlands

Sites which indicate former bloomery operations have been recorded in many parts of the Highlands in the last two hundred and fifty years. The locations of most of the sites described here are included on Figure 10.1, although no attempt has been made to indicate the position of every supposed bloomery site in Scotland (below, Fig.10.1).
Figure 10.1. Charcoal smelting sites in Scotland.
The evidence is in some cases indirect; the records of the Invergarry Iron Company indicate that cinders were obtained from bloomery sites in neighbouring parts of Glen More about 1730 (Fell (1908) 354). In other cases former bloomeries were recorded as a matter of passing interest; in 1791 the minister of Blair Atholl in Perthshire, guided perhaps by his knowledge that the name Dalnacardoch could be interpreted as 'dale of the iron work', observed that smelting holes were still visible; in 1799 Headrick noted that there were many small old furnaces on the upland above Glen Urquhart in Inverness-shire (OSAS V.2 (1791) 477, Headrick (1799) 383-4). More recently sites have been enumerated after superficial examination; Macadam identified and named over ninety throughout the Highlands, and Graham included seven sites among the antiquities of Skipness in north Kintyre (Macadam (1886-7) 96-103, Graham (1918-19) 112-13). As shall be seen later, a few bloomery sites have been deliberately excavated by trained archaeologists or discovered in the course of other excavations.

Although criticism of smelting as damaging to woodland has been directed mainly at the blast furnaces of the eighteenth century, bloomeries have not escaped censure. In a number of cases it has been claimed that bloomery operation was extensive in the seventeenth and early eighteenth centuries; English ironmasters have been held largely responsible, in accordance with the belief that in the
late sixteenth century fuel shortages and the restrictive legislation which followed them led to a retreat into the more remote parts of the British Isles (Scrivenor 1854) 35-7, Darling (1949) 133, Tittensor (1970) 104-5. Tylecote has asserted, on the basis of the archaeological evidence which shall be examined later, that most Scottish bloomery sites were worked between the sixteenth and eighteenth centuries to utilise local fuel; in his view haematitic ores were imported from Furness for the later bloomeries, and those with good fuel reserves were converted and run as blast furnaces until forced out of competition by the development of coke-smelting (Tylecote 1962) 292.

If carried out in the seventeenth and eighteenth centuries, bloomery work in the Highlands may therefore be seen as a development within the main British commercial iron industry. Lowland Scots as well as English ironmasters may have been involved but in the circumstances of the Highlands at the time local proprietors are unlikely to have been instigators. Some documentary evidence is likely to have survived in the form of contracts, official records, court proceedings, or simply casual observations; lowland Scots and literate Highlanders had a common interest in the potential of the region and the progress of anyone attempting to exploit it. Thus evidence concerning the indirect-process works established shortly after 1600 in a remote part of Wester Ross may be collected from a range of sources including parliamentary proceedings and
contemporary records of local history (below, 10.4).

Documentary evidence of bloomery operation is rare, however, and does not suggest commercial production. Sweden was the main source of bar iron for use in Scotland by the sixteenth century, and manufactured iron goods were imported from France, England, and Holland (Lythe (1960) 152, 174, 226, 242). The accounts of the master of works for the period 1529-1615 contain several references to the use of iron from Sweden and other parts of continental Europe, and also a single enigmatic reference to the purchase of 'Hos irne' in 1529; this may indicate iron from Ross, and predates the period when English smelters had any incentive to use Scottish woodland (Paton, ed. (1957) 6, 405).

Accounts of the mid-seventeenth century attributable to Gordon of Straloch and Gordon of Rothiemay describe smelting with local ore and wood in Strathnaver and other parts of Sutherland. The direct process was evidently employed and the product was said to be exported profitably, but the work was carried on by the inhabitants of the district and the iron may have been exported only to other parts of the north Highlands (Mitchell, ed. (1906-8) V.2, 454, Anderson (1967) V.1, 345, Kemp (1887) 296-303). The two Gordons assisted in the production of Blaeu's map of Strathnaver, on which a single iron production site is marked on the upland near Lochan nan Carn on the west side of the valley (Blaeu (1654m), Cash (1901) 402-7).
It is in any case improbable that anyone intending to set up a commercial ironworks in an area without an established smelting tradition in this period would consider using a basic technique which was clearly obsolescent by 1600, especially if imported haematites were preferred to the native bog ores which suited bloomery smelting but not the indirect process. A large commercial bloomery would require a permanent structure, outbuildings, stables, housing, and perhaps a quay for the shipment of ore and finished metal; water-powered blast would also be required, especially if haematites were smelted (Kees (1968) V.1, 175). There is no real evidence of the association of dams, lades, or quays with bloomery operation in Scotland; there is similarly no evidence that the buildings occasionally found near supposed bloomery sites are anything but small habitation sites.

If commercial bloomery smelting is excluded the sites within the Highland area presumably mark points where iron was produced for local consumption; this would explain the small size and primitive nature of most sites, and it is quite conceivable that such bloomeries survived relatively late in the more remote parts of the Highlands (Schubert (1957) 152). Documentary evidence is unlikely to be extensive and in fact proves to be almost totally absent, with the exception of the references to smelting in Ross and Sutherland already mentioned. Some iron appears to have been produced in the early seventeenth century;
commenting on the act anent making of iron with wood passed in 1609, privy council observed that a little iron was made with brushwood, branches, and cuttings, although there was no iron mill in the country (Lythe (1960) 44).

The act in question prohibited the smelting of iron with wood, and in 1610 the manufacture of iron in Scotland was granted as a monopoly for thirty-one years (Cochran-Patrick, ed. (1878) Iviii). Local bloomery work was therefore technically illegal during the first half of the seventeenth century and it might be expected that local court ordinances would follow national statute in this matter as in others, especially if smelting was common enough in the Highlands to be a serious danger to woodland (above, 3.2). Only one case is apparently recorded; in 1627 one Murdo Ross was found guilty of making iron in Inverchaslae by the court of Kincardine in Easter Ross (MacGill (1909-11) V.2, 36). Inverchaslae is probably the present Invercassley, which is in fact on the Sutherland side of the river Oykel, and this may therefore have been part of the Sutherland industry already noted.

A late seventeenth-century addition to an earlier account of the Highlands noted that '... there is much Iron Ore over all the Highland with which they furnished themselves formerly', and later accounts also emphasised that small-scale smelting was a thing of the past (Mitchell, ed. (1906-8) V.1, 160n). In 1779 Donald MacNicol, the minister of Lismore in Argyllshire, produced a rebuttal of Samuel
Johnson's statements about Scotland; in it he claimed that smelting had formerly been universal in the Highlands and islands, but he conceded that little or no iron was still produced and he had evidently never seen it made (MacNicol (1779) 155). By the late eighteenth century tradition about ironworking in the Highlands was concerned principally with former armourers and smiths and was often, as in the case of Glen Turret in Perthshire, incorporated in heroic myth of the remote past (MacNicol (1779) 155, Gillies (1784) 12-13). In some areas tradition was completely absent. In 1799 Headrick was able to find no knowledge or tradition concerning smelting in the vicinity of the Glen Urquhart sites, and Graham found a similar absence of tradition about the Skipness sites in the early twentieth century (Headrick (1799) 383-4, Graham (1918-19) 113).

There is therefore no satisfactory documentary evidence of local bloomery work in the Highlands during the period after 1650, although work in Sutherland and possibly in Ross-shire may have continued for some time after the dates at which it was described. Archaeological evidence of the age of known sites is therefore necessary, but relatively few Scottish bloomery sites have so far been excavated. Primitive metalworking sites in Britain at times contain only slags and groups of metal objects without evidence of a furnace (Schubert (1957) 21). Many of the Scottish sites consist only of low slag mounds of this nature which are inconspicuous and of little direct interest
to excavators, and the bloomeries described in excavation reports tend to be associated with habitation sites or other features of more general interest.

There are also technical difficulties in the dating of primitive bloomeries. The basic technique changed little from the early iron age until the abandonment of bloomery working. Evidence of the presence of tap slags and the use of shaft furnaces is diagnostic of technical advance, but generally serves only to identify sites as belonging to the Roman or post-Roman periods; there is little technical difference between sites which can be dated by other means as originating in the dark ages or the early mediaeval period (Tylecote (1962) 192, 260). Little can therefore be gained from the interpretation of early superficial descriptions; Headrick's account of the furnaces around Glen Urquhart as pipes of wrought clay suggests that they were shaft furnaces and the presence of tap slag on some sites was recorded by Macadam, but this does not permit precise dating within the post-Roman period (Headrick (1799) 383-4, Macadam (1886-7) 96-103).

Macadam's work is also of doubtful value on other grounds. He suggested that there was a general relationship between the type of site chosen and the form of draught employed, with effects on the scale and efficiency of bloomery operation. He consequently outlined a sequence of four types of site on exposed upland, in dry valleys,
by streams in valleys, and by streams on the shore; the last were the largest, probably employing water-wheels to provide blast, and his references to early and late slags make it clear that he regarded these as stages in a process of technical development through time. His principal late sites were at Esmore and Phuill on the shore of Loch Fyne in the parishes of Strachur and Stralachlan, and included extensive charcoal deposits and slags resembling those of haematites (Macadam (1886-7) 90-1, 96-8). Unlike Graham, who worked later on the other side of the loch, Macadam made no attempt to distinguish between bloomery sites and charcoal hearths attributable to the Argyle Furnace Company in the eighteenth century (Graham (1918-19) 109-10, 113).

The lochside 'bloomeries', however, bear a strong resemblance to coaling hearths or shipping points for charcoal, and the Argyle Company is known to have obtained charcoal from these parishes (below, 10.6). It may also be suggested that the haematitic slags on these sites originated in Argyle Furnace or the parent works in Furness, and were brought as ballast by vessels arriving to collect charcoal; such ballast may have been used to build up a level site for storage and loading. Until the extent and date of bloomery operation in the district is established by excavation it is therefore appropriate to question the nature of these sites; even if they are taken as bloomeries, the evidence available to Macadam was too slender to
justify the suggestion of a sequence of technical advance applicable to the Highlands as a whole. It is therefore necessary to rely on the evidence of excavations in which the date of operation can be established by inference from the sequence of occupation layers, the presence of dateable objects, and other forms of circumstantial evidence.

Most of the smelting sites in the Highlands and islands for which reasonably precise dates can be established are early. The two most significant individual sites are at Rudh'an Dunain cave in Skye and Wiltrow in Shetland. A substantial amount of the furnace structure and associated equipment has survived in each case; there is some difficulty in dating but both are probably iron age sites, and not later than the end of the Roman period (Scott (1933-4) 219-21, Curle (1935-6) 153-7, Schubert (1957) 24-5, Tylecote (1962) 195-8). Other sites with less complete evidence of the mode of operation can also be allocated iron age dates; two are in the east Highlands, at Pityoulish in Strath Spey and Loanhead of Daviot in Aberdeenshire, and another Shetland site at Westing on Unst is probably also of the iron age (Kilbride-Jones (1936-7) 401-3, Rae & Rae (1952-3) 158-9, D & E (1962) 41). Sites excavated at Cornaigmore and Feall Bay on the island of Coll, and two on the Argyllshire mainland, at Poltalloch near Loch Crinan and Auchagellan in Glendaruel, also appear to have iron age dates (D & E (1961) 10, (1962) 9-10, (1963) 7-8).
Other sites may be assigned to the Roman era and the dark ages. Large slag deposits and extensive evidence of smelting at the Roman fort of Carpow in Perthshire may be contemporary with the fort or rather later (D & E (1967) 42-3). A site at Fersit in south-west Inverness-shire may belong to the eighth century, although there is some disagreement over the dating of the associated evidence (Ritchie (1941-2) 60, Schubert (1957) 73, Tylecote (1962) 292). A slag and ore mound at Bac Mhic Connain in North Uist and another site at Galson in Lewis both probably belong to the first few centuries A.D.; a collection of iron objects and slag at Garry Iochdrach near Bac Mhic Connain can be dated to the fourth century A.D. (Beveridge (1931-2) 41, Callander (1931-2) 50, Baden-Powell & Elton (1936-7) 354-5). Smelting associated with fortified sites at Dun Cuier in Barra and Ugadale Point in Kintyre appears to have been no later than the seventh century A.D. (Young (1955-6) 315-6, Fairhurst (1954-5) 19-20). At Keil Cave near Southend in Kintyre iron smelting appears to have continued for some time after the third century A.D. (Ritchie (1966-7) 105).

The only site in the Highland area for which a later date can be established with any certainty is at Ardnadam near Dunoon in south Argyll; there a group of platforms and the foundation of a hut are associated with large slag deposits occurring below and on the same level as pottery of the fourteenth century (D & E (1971) 8). The evidence
available therefore suggests that bloomery operation in the Highlands and islands was earlier than the seventeenth century; with the exception of the Ardnadam site there is evidence only of pre-mediaeval smelting. The pattern of excavated sites cannot be taken as representative, however, and important areas have not been examined. Slag deposits have been precisely located near Macadam's supposed large bloomeries in Stralachlan parish but not excavated (D & E (1962) 5); it may also be noted that the platform site at Ardnadam resembles the large number of platforms in Skipness which Graham attributed to eighteenth-century charcoal burning (Graham (1918-19) 109-12). Excavation of these sites may indicate that they are in fact earlier.

Many undated sites are known to exist in Kintyre (Graham (1918-19) 112-13, Anon. (1971) 208). A large number of undated sites on the east shore of Loch Lomond in Stirlingshire await adequate investigation (Anon. (1963) V.1, 56-7, V.2, 444-5). Investigation in Sutherland is likely to provide some evidence about the character and extent of late bloomery operations, although recent investigation at Rosal in Strathnaver revealed only a small quantity of iron slag without associated evidence, on a site which probably predates the deserted township (Corcoran (1967-8) 117, Fairhurst (1967-8) 139-40). Until a systematic investigation of Highland sites is undertaken there can be no certainty about the scale or period of bloomery
operation. Some excavation has been undertaken recently in the south-western counties of Scotland, however, which may shed light on the situation in the Highlands. Reporting on the excavation of a bloomery site at Millhill near Dumfries in 1967, Williams was able to give it a tentative date in the period 1200-1300 A.D; this date, based on pottery in the vicinity, is probably applicable to other sites in the district (Williams (1967) 128-9).

The site consisted primarily of a low slag mound ninety feet (27 m) long and thirty-five feet (11 m) wide on the bank of a stream; there was a considerable quantity of tap slag and the mound contained a simple bowl hearth. There was also evidence of an associated habitation site and Williams suggested that the bloomery was operated intermittently by a family unit, possibly to serve a local rural market (Williams (1967) 126-9). Most Highland slag deposits are considerably smaller; thus the largest of three recently measured on the shore of Gare Loch in Dunbartonshire was only twenty-four feet (7.3 m) in diameter (D & E (1971) 19). If the Millhill bloomery was in fact small and intermittent in operation over a century or less, a number of conclusions may be drawn about the smaller dimensions of Highland slag heaps. Deposits associated with iron age bloomeries in Britain as a whole are notably small, and some undated Highland heaps may therefore be early (Tylecote (1962) 201); in other cases the limited size of the heap may indicate that the site was used for a very
short period. It is also possible, however, that some sites identified as bloomeries have a different origin.

There is some difficulty in distinguishing between early smelting and smithy sites. In Britain in general the primitive forge fire appears to have had some resemblance to the early smelting furnace, although the bowl form and stone hearth may not have been employed; the resulting forge cinders resemble primitive smelting slag and cinders. Certain features allow definite identification of a smelting site; tap slag was produced in smelting but not in forge work, and the presence of appreciable quantities of ore and large slag deposits also indicates that smelting was carried on (Tylecote (1962) 192-3). Small mounds apparently consisting of primitive slag, however, cannot be positively identified as bloomery sites if tap slag, ore, and the remains of a furnace are absent; such mounds are not uncommon in the Highlands and may in fact mark sites where bar iron made elsewhere was worked, especially if they lie in or near habitation sites.

It should also be noted that the destruction of woodland cannot immediately be inferred from evidence of the existence of a bloomery or forge site. As already noted, both wood charcoal and peat charcoal were suitable for primitive bloomery operation; both forms appear to have been employed on iron age sites in Scotland, and Macadam found indications of the use of both among his undated
sites (Macadam (1886-7) 96-103, Tylecote (1962) 195-8, above, 10.2). There is also adequate evidence that later Highland smiths used peat charcoal frequently. The making of peat coals for smithy work continued longest in the treeless western islands and was still practised early in this century. Ross, writing in 1885, had seen peat charcoal made in Jura (Ross (1885-6) 409); writing slightly later Macadam considered that the practice had ended, but it continued in North Uist and other islands until the early twentieth century (Macadam (1886-7) 95-6, Crawford (1964) 109-12).

Some peats were charred in pits in the house floor but the best smithy fuel was made from hard and compact black peats charred in pits on the moors; this may provide an explanation for the 'smelting holes' seen around Dalnacardoch (Macadam (1886-7) 95-6, Crawford (1964) 111-12). The use of peat charcoal was not confined to the islands; in 1799 Headrick observed that black peats were coaled and used by Highland smiths, but by then mineral coal appears to have replaced peat charcoal on the eastern fringes (Headrick (1799) 395). Thus in 1726 an ordinance of the baron court of Urie in coastal Kincardineshire prohibited the 'potting' of certain mosses except by the smith for his coals, but by 1816 the coaling of peat had been completely forgotten in coastal Morayshire, as Saunderson found when he experimented with peat charcoal after seeing it in use in Holland (Barron, ed. (1892) 130, Saunderson
There appears to have been a further decline by the middle of the century, when Campbell of Islay proposed the use of Highland peat to make high-quality iron without any evident awareness of its local use in metalwork (Campbell (1843) 599-600).

It is also possible that bog timber was coaled; in the sixteenth century such wood was commonly extracted from peat bogs in the Pennines, and Fell later suggested that it provided a source of fuel for the small bloomeries of Furness, especially those on upland sites (Fell (1908) 165). There is no evidence of such a use of bog timber in the Highlands, which is scarcely surprising in view of the small amount of documentary evidence relating to bloomery operation, but it cannot be excluded from the range of fuels used when bloomeries were in operation.

It may be said in conclusion that the rarity of documentary evidence about bloomery operation in the Highlands after 1600 is not in itself definite proof that iron smelting was absent from most districts, although it can be said with some confidence that commercial bloomery operation was not carried out. The archaeological evidence available is also limited, and general statements on the archaeological status of Highland bloomeries cannot be justified until the systematic excavation of probable sites has been undertaken. Taken together, however, the two forms of evidence indicate that bloomery iron production was very uncommon and localised by the seventeenth century and
absent in the eighteenth. Both forms of evidence also indicate that the charcoal of fresh timber was not the only fuel employed. Bloomeries played a negligible part in the use of timber in the seventeenth and eighteenth centuries; the small scale of operation and the availability of alternative fuels suggest that they never contributed significantly to the destruction of woodland in the Highlands.

10.4 The indirect process in the Highlands, 1600-1700

Several attempts were made to found charcoal blast furnaces in Scotland; the sites of these ventures are indicated by Figure 10.1, with the exception of two cases in which the precise site of unsuccessful attempts is not known (Fig. 10.1). In 1609 the parliament of Scotland passed an act prohibiting the production of iron with wood. According to the preamble certain mines and woods had remained undiscovered or unused in the savage parts of the Highlands until recently, and certain persons planned to found ironworks in the present period of peace; this would destroy woods better employed for other purposes and especially the smelting of more valuable metals (Cochran-Patrick, ed. (1878) iviii, 138-9). This act may have been designed to prepare the way for the monopoly of the manufacture of iron and glass in Scotland for thirty-one years granted to Sir George Hay of Netherliff in 1610 and confirmed by parliament in 1612. In 1613 another act was passed prohibiting the export of iron ore, to encourage
those who had developed the art of iron production, and in 1621 Hay was permitted to transport iron made by him to the port of any burgh (Cochran-Patrick, ed. (1878) lvi, 162-3).

Sir George Hay, later earl of Kinnoulli, had an iron-works at Letterewe on Loch Maree in Wester Ross; he and two partners appear to have acquired the use of the site and woods from Mackenzie of Kintail in exchange for rights to lands in the Hebrides (Macadam (1886-7) 110). Work started about 1609 but the exact date is uncertain; the furnace was staffed by Englishmen and references to the casting of cannon indicate that the indirect process was employed. A late seventeenth-century manuscript history recorded that one Farquhar MacRae was sent as minister to the colony of Englishmen making iron and casting cannon at Letterewe under Sir George Hay of Airdry; this man stayed for about ten years before becoming minister of Kintail in 1618 (Scott, ed. (1915-28) V.7, 146). Hay died in 1634, and work apparently continued under the local proprietor, by then created earl of Seaforth; another late seventeenth-century manuscript related the story of a man from the Inverness district who in 1634 or shortly afterwards went to have gold changed at Letterewe, where there was an English forge and ironworks under Seaforth (Mackay, ed. (1905) 270).

The source of initiative for this works is uncertain. An English ironmaster interested in smelting in Scotland
would find it advantageous in overcoming public objections to have a prominent Scot playing a real or nominal part in his enterprise, and Hay may have had such a role. It is more likely that Hay found English skills in smelting necessary for the success of his own venture; in either case, it is probable that Mackenzie of Kintail guaranteed protection against molestation. Despite the permission granted in 1621 to transport iron to the burghs it is possible that most of the metal went to English markets, and there is no evidence that Letterewe iron was significant in the domestic supply. It is also uncertain at what time the works was closed; local tradition of the nineteenth century suggests that it was still in operation in the late seventeenth century, but an account of the Highlands which was probably written before 1661 stated that iron mines at Letterewe were no longer worked; furnaces were frequently but incorrectly associated with the working of mines, and this provides reason to believe that the furnace had closed by about 1650 (Macadam (1886-7) 123, Mitchell, ed. (1906-8) 445).

There are three separate furnace sites around upper Loch Maree. The furnace of Letterewe itself as described by Macadam was a substantial stone and brick building; some local bog ore was used but there are traces of haematites, probably of Furness provenance, and carboniferous ores resembling those of Fife. At Cheardach Ruadh above the head of the loch there is another apparent blast-furnace site. The remains of a stone and brick furnace are associated with
a casting floor, dams and lades; ironstone and haematites like those at Letterewe were found on the site, and may have been mixed for smelting (Macadam (1886-7) 109, 113-15, 119-22). Finally, at Fasagh near the head of the loch there is a site containing large quantities of primitive slags derived from bog ores. This initially suggests a bloomery, but it may have been a blast furnace; Macadam identified casting beds on the site, which would not be required in bloomery work, and slags like those on the site might be produced in a blast furnace using bog ore with little or no limestone as flux (Macadam (1886-7) 106-9, Tylecote (1962) 292).

If the three sites were operated in succession smelting may have been carried on for a longer period than documentary evidence suggests; if they were simultaneously in production the region was clearly not unimportant as a source of iron, although Macadam's assertion that it was a 'veritable iron forge for the whole of Britain' is an undoubted exaggeration (Macadam (1886-7) 104-6). Excavation of these sites and investigation of their possible connection with local bloomery operation may provide more information about the history of smelting in Wester Ross.

Attempts to exploit the mineral resources of the Highlands were common and almost invariably unsuccessful; lead was discovered in almost every district of the south Highlands and in many cases was mined for a short time,
but only three sites proved to be of sustained value (Smout (1967) 103-5). Most attention was paid to silver, lead, copper and other valuable metals, but there is evidence of a similar interest in the mining of iron before 1700. Thus Sir David Lindsay of Edzell in Angus and his brother John, who succeeded in being appointed Master of the Metals in 1592, indulged in several short-lived attempts to profit from the metals on their lands at the end of the sixteenth century (Lindsay (1849) V.1, 342-5, Jervise (1853) 82, Cochran-Patrick, ed. (1878) lxi-ixv). Equipment was set up in this period to smelt local iron at the wood of Dalbog, three miles (4.8 km) north of Edzell; this attempt was evidently a failure and subsequent generations of the family concentrated on the mining of lead (MacNair, ed. (1883) 24-5).

There is evidence of similar speculative work in south-west Inverness-shire, where in the late seventeenth century Cameron of Locheil was said to be building an iron mill (Mitchell, ed. (1906-8) V.2, 160n); in the absence of further evidence it may be assumed that this attempt was also unsuccessful. In other cases an interest in smelting was expressed but not put into practice. Thus in 1631 Sir John Grant of Grant agreed to enter partnership with the purchaser of woods in Strath Spey if ironstone was discovered, and share the costs of building an ironworks. In another contract of 1634 he reserved privileges concerning 'the ironworks in Urquhart', although the terms of the contract
make it clear that this works had not yet been built
(Nairne (1890-1) 195-6, Anderson (1967) V.1, 312-3); the
wording of this contract misled at least one later author
into assuming that the works was in production, although
there is no evidence that this was so (Mackay (1893) 451).
Apart from the works at Letterewe there is no real evidence
of furnace operation until the second decade of the eight-
teenth century.

10.5 The indirect process in the Highlands, 1700-50

Macfarlane's Geographical Collections contain a de-
scription of Aberfoyle parish in Perthshire in 1724, which
records the existence of a new ironworks producing good
iron from 'tar' obtained locally and iron scraps from Hol-
land; a local birchwood was the source of fuel (Mitchell,
ed. (1906-8) V.1, 343). Recycling of scrap iron was ac-
cepted practice in charcoal blast furnace management, and
the recent suggestion that an early transcription error
led to the substitution of 'tar' for 'oar' (a spelling var-
iant of 'ore') is probably correct (Schubert (1957) 232-4,
Emery (1959) 14). According to the description the works
was on the boundary of Callander parish three miles (4.8 km)
north of the church of Aberfoyle; it was probably located
at the west end of Loch Achray, where the head of water of
the river from Loch Katrine could be utilised (Mitchell, ed.
(1906-8) 343).

Aberfoyle parish was part of the Montrose lands and
contracts relating to the works are contained among the Montrose muniments. In April 1718 two Irishmen named as John Smith in Castlefinn (Donegal) and John Irvine in Newtownwood (Tyrone) purchased the woods of Inchcailloch in Loch Lomond and a division of the Menteith woods, to be cut in four and seven years respectively. Liberty was given to make charcoal and to mine iron ore in Menteith and Buchanan; they were also allowed to erect an iron mill with outbuildings, dams, and lades at any convenient point within the lands of Buchanan and Menteith (SHO GD.220 [Wm.11]). In October 1718 John Smith alone purchased a ten-year cutting of the barren timber of the Montrose woods on Loch Katrine, with liberty to make charcoal (SHO GD.220 [Wm.12]). This suggests that the report of 1724 was substantially correct; the woods on Loch Katrine were the only extensive area of birch and other barren timber around Menteith, and a site in the location indicated would be well placed for the delivery of charcoal from these woods (SHO GD.220 [Wm.16]).

The works almost certainly remained in operation for no more than the ten-year period of the second contract. The absence of Irvine's name from the second contract suggests that he had abandoned the project, and the contract for woods in Buchanan and Menteith had been assigned to a local man by 1723 (SHO GD.220/6 (30), 514). As only this contract contained permission to build an ironworks the assignation may mark a change of ownership or abandonment
of the scheme. In 1728 the contract for the birchwood expired and it was noted in 1735 that these woods had not been sold since this contract; in 1728 the next division of the Menteith oakwoods was also sold, to another local man (SRO GD. 220 [Wm. 13, Wm. 16]). The woods of the estate were no longer directly available, and although work may have been continued with charcoal bought from other estates or from the bark merchant cutting the oak woods, there is no record of the payment of site rent for an ironworks in the period after 1728.

Four other works were opened within the next fifteen years, but none was successful and all had closed by 1750. A blast furnace had been built by an Irish partnership at the mouth of Glenkinglass on Loch Etive by 1725; two were erected in Inverness-shire, at Invergarry in Glen Mor and near Abernethy in Strath Spey. The Invergarry works, run by a partnership from Furness, was in operation after 1727, and the Abernethy furnace, one of the York Buildings Company's enterprises, was producing iron by late 1729 or early 1730. There is also some evidence about a works near Muirkirk in Ayrshire in the 1730s; this is the only charcoal blast furnace in Scotland outside the Highland area about which any satisfactory evidence has survived.

In May 1725 a deed of copartnery in woods, ironworks and other subjects was signed by Arthur Galbraith, Esq., of Dublin, Roger Murphey, tanner in the same city, and two residents of County Meath, Charles Armstrong of Mountarm-
strong and Thomas Ketlewell, Gent., of Thomastoun (SR0 SC. 54/12/11 [e]). Between June and September of the same year a number of protests of bills, a form of legal evidence of demands for payment, were brought against Galbraith and Murphey singly or together; in several they were described as residenters in Glenkinglass, and a protest registered in June 1725 named Edward Hill as 'Clark to Captain Galbraith & Company residenters at Glenkinlis Furnace' (SR0 SC.54/12/11 [a]).

As already noted, Murphey purchased cuttings of a number of woods of oak and barren timber in north Argyllshire and the adjoining part of Inverness-shire in late 1721 and early 1722; in May of 1722 Galbraith and Murphey entered a contract of copartnership, mentioned in other manuscripts but no longer extant, and in July 1722 Murphey assigned his contracts to Galbraith for cash, with power under a backbond to reclaim a half share upon payment of the appropriate sum (SR0 SC.54/12/10 [c], SC.54/12/11 [b]). The copartnership of 1722 provides a likely initial date for the furnace scheme; available summaries of Murphey's earlier contracts make no mention of any privileges concerning the coaling of timber and the use of iron ore (SR0 SC.54/12/11 [b]). Although it is likely that a tack of lands for the furnace site was obtained from Campbell of Lochnell, the proprietor of Glenkinglass, written evidence of this appears to have been lost.
During the operation of the furnace there appear to have been continual financial problems in the management of the furnace and the wood contracts; shares in the timber were repeatedly assigned and reallocated among the partners and other Irish merchants. In 1726 Armstrong formally relinquished his share in the enterprise, and in 1727 Charles Coyle, one of the company clerks, found it necessary to register a protest for £25 sterling against the partners (SRO SC.54/12/11 [s] [g]). The remaining partners of 1725 appear to have sold their interest in the furnace by 1730. There is no evidence that Galbraith, Murphey or Ketlewell were concerned with the furnace after 1727. Galbraith assigned his share of the Glen Orchy timber contract to Lochnell about that time, but was still resident in the district in 1732 (SRO SC.54/12/12[c]).

A protest of 1730 described Murphey as copartner in the woods of Glen Orchy; he and Galbraith had been the original partners in the purchase of the Glen Orchy pine-woods in 1723 (SRO SC.54/12/12[b], above, 5.7). In January of 1732, however, one Roger Murphey, resident in Glenliart in Glen Orchy, was tried in Argyll Sheriff Court and found guilty of the murder of his servant Francis Galbreth; it seems very unlikely that this was not the same Murphey (Imrie, ed. (1969) 452, 454).

Charles Coyle, the clerk of the Glenkinglass company, was a member of the jury, which suggests that Murphey had
not been associated with the furnace for some time (Imrie, ed. (1969) 454-5). Fell suggested that the works was abandoned in 1731; this may have been deduced from entries in the Invergarry Company accounts of that year which indicate the transfer of workmen, coalers and horses from Glenkinglass (Fell (1908) 379-81). Work continued after that year, however, and in 1733 Charles Coyle registered another protest dated April 1732 in which he described himself as storekeeper at Glenkinglass (SR0 5G.54/12/12[d]). There had already been a certain amount of contact between the managements at Glenkinglass and Invergarry, and the transfer of men and animals may have been a form of temporary assistance made possible by one of the long pauses in production which were common in the charcoal iron industry (Fell (1908) 311-2, 353, Macadam (1886-7) 125).

Fell was also mistaken in supposing that the Glenkinglass plant was owned by the York Buildings Company; this error appears to have arisen from misinterpretation of a note in the Invergarry accounts which more probably refers to a visit by representatives of Invergarry and the York Buildings Company to Glenkinglass (Fell (1908) 353). The only evident contact with the York Buildings Company was in 1730, when castings were ordered both from Invergarry and Glenkinglass for the lead smelting plant at Strontian (Fell (1908) 380-1, Murray (1883) 64n). It is not certain who succeeded the Irish partnership in control of Glenkinglass furnace, but the available evidence indicates
Daniel Campbell of Shawfield.

Campbell of Shawfield was a Glasgow merchant who became proprietor of Islay in 1725 or shortly afterwards (DNB V.8 (1886) 355). Writing in 1740 about his attempts to encourage metal-working in the Highlands, Murray of Stanhope noted that Shawfield and company were smelting iron with ore from Jura, Islay, and Lancashire at a furnace which had been erected at Murray's instigation by an Irish gentleman (Murray (1740) 12). It is probable that the Irish gentleman was Arthur Galbraith and that the furnace was in Glenkinglass; no other Irish venture is known and Murray's interest in Argyllshire extended back to the period when Galbraith and Murphey entered partnership (Paton, ed. (1913) V.1, 190). Supporting evidence is provided by Cowley's map of Argyle's Dukedom, dated 1734 and prepared by Cowley from earlier maps with additional material based on verbal descriptions by Murray of Stanhope, who published the map and a note by Cowley in his book of 1740 (Murray (1740) 18). The map includes the whole of Argyllshire but marks only one iron furnace, that of Glenkinglass (Cowley (1734m)).

Independent evidence of Shawfield's interest in smelting is provided by an undated sheet among the Seafield papers, headed 'Questions and Answers anent the Iron Ore'; it summarises the answers provided by Shawfield and Sir Robert Clifton, who was involved in Highland lead-mining for about twenty years after 1724, to questions about the
value of iron ore and the costs of smelting and coaling
(SRO GD.248/135 (1)). The information was presumably
used to assess the feasibility and value of iron smelting
on the Grant estate and it is evident that Shawfield was
regarded as an expert in the field; the sheet was perhaps
prepared in 1728 or early 1729, when the York Buildings
Company obtained the right to build ironworks on the Grant
lands in Strathspey. In 1738 Shawfield was evidently a
partner in the contract for the cutting of the Glen Orchy
pinewoods, in company with Campbell of Lochnell (SRO GD.
112/16/11[c]).

The date at which smelting in Glenkinglass terminated
is uncertain, although it can have been no later than 1752,
when the Lorn Furnace Company purchased the woods of Loch-
nell's lands (below, 10.6). There was a general depression
in the iron industry in 1737 and 1738 (Awty (1957) 109).
In February 1739 Campbell of Lochnell issued a series of
nineteen-year tacks of farms in Glenkinglass and other parts
of his lands, most of which were prorogations on existing
leases; the only lands allocated to new tenants without
evidence about the previous tenancy were those of Ardmaddy,
on which the furnace was located, Acharn in Glenkinglass,
and Inverliever on Loch Etive immediately south-west of
the mouth of the glen (Paton, ed. (1913) V.3, 61-2).
These lands may previously have been leased to the company.
The Military Survey sheet of the area was prepared from a
survey made between 1747 and 1752 and marks an iron forge
in the appropriate position; it is possible that the
surveyors, who were interested in features of future mil-
itary significance, considered the closed works as capable
of restoration to use (M.S. (1747-55 m) 14/4).

The plant was certainly a blast furnace; this is indi-
cated by the production of castings for the York Build-
ings Company, and Cadell found a few pigs from the furnace
kept in a cottage near the site (Cadell (1913) 148). It
seems to have been small, however, and there is no evid-
ence of a finery. As already indicated, both local ores
and Furness haematites were smelted, and the site was
still scattered with red haematite in 1912 (Cadell (1913)
148). Wood charcoal was probably the main fuel although
Macadam, whose account in this case is inaccurate and seems
to have been derived from later local memory, stated that
abortive experiments had been made with peat charcoal (Mac-
adam (1886-7) 124). Information about this works is lim-
ited and certain aspects remain obscure; thus there is no
evidence about the markets to which the finished pig was sold.

Relatively little need be said about the furnaces at
Invergarry and Abernethy; both operated for less than ten
years, and they are the only Highland furnaces about which
accurate accounts have been published. The Invergarry
papers were examined at length by Fell and briefly by Ham-
ilton, and the history of Abernethy furnace was described
by Murray in his survey of the York Buildings Company
(Fell (1908) 343-389, Hamilton (1963) 189-91, Murray (1883) 64-5). Both are of interest, however, in demonstrating the problems of ironworking in the interior of the Highlands.

The history of smelting at Invergarry can easily be summarised. A contract for the use of Macdonald of Invergarry's woods over thirty-one years was signed in March 1727, giving the liberty to make charcoal, mine iron ore, and build an ironworks; the furnace was blown in during August 1729 but ceased production at the end of 1735, two months before the concern was officially closed in February 1736. The furnace was in blast for only half of this working period of less than seven years (Fell (1908) 349-52, 355). A number of reasons may be suggested for this rapid collapse. The Furness partnership responsible for the works was acting independently; the resources of a parent company were therefore not available to cover the costs of initial operating difficulties, although there was informal contact with the established Backbarrow Company in Furness.

There is little evidence that any serious attempt was made to reduce wage and carriage costs by the use of local labour and materials. Most of the materials used in construction of the furnace were imported and assembled by imported craftsmen and the furnace was staffed largely by men from northern England; most of the coalers were brought from Ireland and provisions were supplied mainly by an
agent in Furness (Fell (1908) 351, 360-5). The site was twenty-two miles (35 km) by land and water from the quay at Corpach on Loch Linnhe; cart roads and boats had to be built to carry ore, provisions, and pig. The journey was slow and expensive, included a land-water transfer at the foot of Loch Lochy, and was liable to delay in bad weather; this contributed to the erratic operation of the furnace and increased working costs. Carriage of ore from Corpach cost as much as the far longer sea haul from Furness; and attempts to find adequate ores locally were not successful (Hamilton (1963) 191, Fell (1908) 352-3). Finally, Invergarry pig was poor in quality; carriage costs to market areas were high but the metal could be sold for only seventy per cent of the market price of Furness pig (Fell (1908) 355). As shall be seen later poor quality was not an intrinsic characteristic of Highland pig, but the company did not have the resources to survive until quality reached a competitive standard.

Abernethy furnace survived for an even shorter time. The York Buildings Company started timber working around Abernethy in 1728; an indenture of March 1729 allowed them to prospect and mine minerals, and erect and operate furnaces on the lands of Grant over a fifty-year period (SHO GD.248/68 (3)). A letter written by a Grant estate agent in February 1730 noted that the iron mill would be working again in late April; it is therefore evident that it had already been briefly in blast. According to the same
letter company agents were negotiating with the laird of Macintosh for woods in Badenoch; the company had a large supply of pine timber but it is clear that here, as in other cases, pine charcoal was found unsuitable (SRO GD. 248/135(1), below, 11.5). Although the works was quickly in use the furnace accounts showed heavy losses by 1732; in 1734 and 1735 the factor impounded furnace equipment to recover debts owed to the estate (Murray (1883) 64-5). An inventory taken for this purpose in August 1734 indicates that the works, which was located near the company sawmill at Culnakyle by Nethybridge, included both a furnace and a forge (SRO GD. 248/135 (1)).

There is no evidence that the furnace survived the financial difficulties of 1735, and the general irregularity of the company’s affairs at this time probably contributed to its demise. The work was in itself a poor proposition, however, and its position forty miles (64 km) from the coast was even less favourable than that of Invergarry. Pig could be shipped down the Spey in small consignments but the works was poorly placed to serve southern markets, especially those of the west coast of England, and it would have been inordinately expensive to bring Lancashire haematites up Strath Spey. The furnace therefore relied entirely on Highland ores; haematites were brought from the Lecht near Tomintoul, over twenty miles (32 km) of rough country (Forsyth (1900) 200-1, Macgregor et al. (1920) 203). It is doubtful whether this works could have con-
tinued operation for long even under competent management.

The works at Nether Wellwood or Terreoich near Muirkirk in eastern Ayrshire was in a comparable position, nearer markets but dependent on overland transport. Little is known about the works, which appears to have been built after 1732 and closed within a few years. It was described as a forge, but the terms 'forge' and 'furnace' were often treated as synonymous, and it may be inferred from the presence of haematitic ores within five miles (8.0 km) of the site that it was in fact a blast furnace (Macgregor et al. (1920) 3-4, 209). The ores were of some value and there is unconfirmed evidence that shipments were later sent to Lorn Furnace; the presence of ore appears to have been the main reason for location on this site, which was apparently abandoned as a result of the scarcity of coalwood and the unreliability of the supply of peat charcoal (Baird (1910) 44-5, Hume & Butt (1966) 162).

10.6 The indirect process in the Highlands, 1750-1880

Shortly after 1750 the only two works of any real significance in the Highlands were opened in Argyllshire. Both were charcoal blast furnaces originating in Furness, and both continued in operation for over fifty years. It was suggested earlier that several major operating problems led to the rapid abandonment of the earlier Furness enterprise at Invergarry, and it is significant that these problems were largely absent from the operation of the later
works (above, 10.5). Both were branches of established companies, and both made use of local labour and materials as well as the import of specialised skills. The later furnaces also had coastal locations which allowed the shipping of materials to and from the west coast of England without trans-shipment for overland haulage, and permitted the shipping of charcoal from relatively remote coastal areas. Finally, the quality of the metal produced was generally high; Argyle Furnace was closed during the general decline of the charcoal smelting industry in the early nineteenth century, but the metal produced at Lorn Furnace was high enough in quality to ensure that the works was one of the four British charcoal furnaces remaining after 1850 (Schubert (1957) 358-65).

The history of Lorn Furnace, run by the Newland Company of Furness at Bonawe on Loch Etive, will be examined later and is only briefly summarised here. In 1752 Campbell of Lochnell gave the Newland partners a lease of extensive lands around Bonawe for 110 years, and the partners also negotiated agreements for the long-term supply of charcoal from the lands of the earl of Breadalbane. No forge was built, and the furnace produced only pig iron for the markets of Wales and the west coast of England. The works was managed from Furness through an agent at Bonawe and Furness was also the principal source of ore; charcoal was obtained from the woods purchased in 1752 and from short-term purchases of coalwood throughout north
Argyll and south-west Inverness-shire. The lease of lands was renewed on expiry in 1863 and the furnace remained in operation until 1876.

Argyle Furnace was built in 1755 near the present village of Furnace on Loch Fyne; the claim made by some authors that it was founded in 1775 is an error explained by the appearance of that date on the lintel of the surviving furnace structure (Fell (1908) 411, Hamilton (1963) 192). Confusion is also introduced by a series of alternative names. The works was also known as Inveraray, Craleckan, or Goatfield furnace; Inveraray is the nearest town, and the other names belong to farms adjacent to the site. The name Goatfield was also taken by some authors as a corruption of Goat Fell, and therefore as evidence that another furnace was built on the island of Arran (Kemp (1887) 295).

Around 1750 the supply of coalwood in Furness and district was insufficient for expansion of the industry locally, and most was controlled by a number of established furnace companies (Fell (1908) 411). Companies unable to obtain sufficient fuel to expand production were therefore obliged to survey other districts where timber was more plentiful; Lorn and Argyle furnaces originated in a process of dispersal which led to the building of furnaces in north and west Wales at the same time with Furness capital (Awty (1959) 112-3). Argyle Furnace was owned by the Duddon Company (Kendall & Co.), who negotiated contracts with the
third duke of Argyll for a charcoal supply and a furnace site in 1754 (NRA.0006, 207, 246). The furnace was under construction in 1755 and ore was shipped to Argyll in February 1757; coals were being shipped to the company’s furnace at Duddon as early as March 1756 (Awty (1957) 113).

There is little direct evidence about the Duddon Company, either in Furness or Argyll (Fell (1908) 411-2). The furnace was inspected in 1759 by a partner in the Carron works, but little more information is available about the works before the end of the century (Cadell (1913) 146). Unlike Lorn Furnace the Argyle works had a fining forge, at least in the later years (OSAS V.4 (1792) 563). Like the Lorn works, however, the Argyle furnace had an assured long-term supply of charcoal. The contract with the duke of Argyll allowed them three cuttings of certain woods; the Argyll estate coppices were generally cut on a nineteen-year rotation, which suggests that the supply terminated in 1811 or 1812 (OSAS V.5 (1793) 298n). In March 1799 the fifth duke advertised the sale of woods in the districts of Cowal, Knapdale, and Argyll; eleven years' cutting was available and under the terms of their contract the Argyle Company was to be allowed to buy the coalwood or manufactured coals at set prices (Anderson (1967) V.2, 85).

The Argyle managers also purchased additional woods on short-term contracts; the two companies maintained a tacit agreement about the allocation of coalwood, and the Argyle company had little competition south of Loch Awe.
The manager bought a three-year cutting of woods in Glendaruel in Cowal at a roup in 1792 and in the following year the minister of Strachur and Stralachlan, also in Cowal, observed that the furnace provided a constant demand for charcoal (SRO GD.1/390 (54), OSAS V.4, (1792) 563). This demand ceased when the works closed about 1813 (Fell (1908) 412). The rise of coke-smelting had serious effects on the charcoal-smelting industry and twenty-one charcoal works in England and Wales closed between 1780 and 1810, leaving only five in England and the two in Argyll (Schubert (1957) 358-55). The termination of the Argyll wood contract may have been seen as an opportune time for the closure of Argyle Furnace.

A final and relatively unimportant demand for Highland charcoal came from ironworks in lowland Scotland. The Carron works in Stirlingshire, first in blast in 1760, was designed for coke smelting, but a charcoal supply was thought advisable in the early years in case coke proved unsatisfactory and charcoal was also of value in the forge (Campbell (1961) 28). In the 1760s the company prospected widely for charcoal; attempts were made to obtain supplies from north England and woods in Glenmoriston in Inverness-shire were bought for this purpose (Campbell (1961) 33, 50). An attempt was made in 1764 to buy the timber of woods on the annexed estate of Perth (SRO E.777/133/1-2). Although coke-smelting was successful at Carron, forges there and at other points in the lowlands still required
charcoal as fuel, and much of the small demand appears to have been met by coppice in Perthshire; thus in 1760 the Smithfield Company of Glasgow acquired woods in southwest Perthshire with the intention of preparing charcoal for their iron manufactory in Glasgow, which in the circumstances was probably a foundry (SRO E.721/5, 19). When the iron industry of lowland Scotland expanded at the end of the eighteenth century mineral coal came into general use as a forge fuel (Robertson (1794) 96-7, Campbell (1961) 2-4). As late as 1800, however, the Carron Company was using charcoal from the birchwoods of Loch Katrine (Garnett (1800) V.2, 176).

10.7 The effects of iron smelting on woodland

It is clear from the evidence available that the role of iron smelting in the destruction of woodland in the Highlands has been greatly overstated. Bloomery working was of no significance in the Highlands after 1650, and if the schemes which failed to come to fruition are excluded only ten charcoal blast furnaces were built and operated in Scotland, including the three sites near Loch Maree. Nine of the ten were in the Highlands, but three are known to have survived for less than ten years and only Lorn Furnace remained in operation for substantially more than fifty years. It may be pointed out that fifty-six charcoal furnaces were built in the county of Sussex alone between 1500 and 1650, and that one hundred and sixty works were
built in Ireland in the seventeenth and eighteenth centuries (Schubert (1957) 354-7, McCracken (1971) 90).

Another indication of the limited importance of iron smelting in the Highlands may be obtained by comparison of the accumulated working lives of charcoal blast furnaces in Scotland as a whole and in Sussex, which is little larger than the district from which Lorn Furnace obtained charcoal. Even in a generous estimate the accumulated lives of Scottish charcoal furnaces do not amount to 300 furnace-years; the corresponding total of 4,800 furnace-years in Sussex is much greater even after allowance has been made for the relatively small average size of furnaces in the county (Schubert (1957) 354-7). It should also be noted that charcoal furnaces were seldom in blast for a full year; between 1763 and 1780 Backbarrow furnace in north Lancashire was in blast for a full working year only three times and the average length of blast was less than thirty-nine weeks (Awty (1964) 31-3). Longer stoppages were not uncommon; in 1788 Argyle Furnace was expected to be out of blast for several years, and Lorn Furnace was in blast for only thirteen of the twenty-two years of the period 1855-76 inclusive (Fell (1908) 312, Macgregor et al. (1920) 4).

It may finally be noted that the scale of production in the Highland works was very much smaller than that of later stages of the iron industry; production was clearly
a major determinant of fuel consumption. The annual make at Backbarrow furnace between 1763 and 1780 varied from 321 to 862 tons (326-876 t), and averaged 608 tons (618 t); the declared production of Lorn and Argyle Furnaces was 700 tons (711 t) in each case in 1788 (Scrivenor (1854) 88, Awty (1964) 31-3). The average annual production of British coke furnaces in 1806 was 1,546 tons (1,571 t) and by 1823 some furnaces were producing more than 3,000 tons (3,048 t) per year (Scrivenor (1854) 99, 134). By the 1890s furnaces capable of producing 3,000 tons per week were in operation in Britain, and large furnaces now produce over 10,000 tons (10,160 t) per week (Gale (1967) 117).

Iron production in the Highlands was therefore insignificant in comparison to the contemporary density of furnace operation in other parts of the British Isles and minute in relation to later developments in the iron industry; the transport difficulties which hampered operations in the Highlands make it unlikely that the few works were able to exploit the woodland of vast areas. It therefore appears initially improbable that smelting can be regarded as a major contributor to woodland clearance during the period. The evidence examined has largely been circumstantial, however, and it is possible that the fuel requirements of the small smelting industry of the Highlands had disproportionate effects on the woodland of the districts accessible to the furnaces. Lorn Furnace was the longest-lived of the Scottish charcoal furnaces; examination of
the operating methods and fuel consumption of this works will give an indication of the true scale of pressure on woodland resources.

10.8 Summary

Iron is smelted by one of two processes. The direct or 'bloomery' process was in commercial use in Europe before 1550, produced solid malleable iron direct from the ore, and suited small-scale production with primitive equipment. The indirect or 'blast-furnace' method produced liquid cast iron and was more efficient, but unsuitable for intermittent small-scale production.

There is evidence of the use of the direct process in the Highlands, but it is apparent that it was not commercially employed in the region after 1650. Highland bloomery sites probably indicate production for local use; this was recorded in northern Scotland as late as the early seventeenth century, but present evidence does not indicate bloomery working in other parts of the Highlands after the fourteenth century. The available evidence as a whole suggests that bloomeries were insignificant in the use of timber in the Highlands after 1650.

The first blast furnace in the Highlands was apparently built in Wester Ross about 1609; five furnaces were operated for short periods after 1715, four of them in the Highlands. Shortly after 1750 two blast furnaces were
established in Argyllshire, both remaining in operation for fifty years or more; between 1750 and 1800 lowland forges also used a small amount of Highland charcoal. Iron production in the Highlands was insignificant in relation to other British iron-smelting districts at the time and later developments; it therefore appears improbable that smelting had any significant effect on Highland woodland in the period.
CHAPTER ELEVEN

THE OPERATION OF LORN FURNACE, 1786-1813

11.1 Introduction

There can be no doubt that Lorn Furnace was built in Argyllshire primarily to utilise local supplies of fuelwood. Most of the other raw materials had to be imported, the product was marketed entirely in England and Wales, and the area possessed no body of ironworking skills. In the quantities required charcoal was the most expensive part of the furnace charge. In the first half of the eighteenth century charcoal accounted for slightly less than sixty per cent of the cost of producing a ton of pig in Furness; in the second half of the century prices were generally about thirty per cent higher and the quantity required to produce a ton of pig rose. Thus in 1727 Backbarrow furnace needed 1.54 dozens of coals per ton of pig at about 29/6d per dozen, but by 1778 2.14 dozens were required at marginally less than 40/0d per dozen (Fell (1908) 236). Charcoal by then accounted for about seventy per cent of the cost of the furnace charge and efficient use of coals was vital to profitability; the profit margin on a ton of Backbarrow pig in 1765 was more than four times as large as in the
previous year, and that was caused mainly by the use on average of only 1.99 dozens of coals per ton in comparison to 2.55 dozens in 1764 (Awty (1964) 23). Absolute and proportionate increases in the cost of charcoal were not the only significant factors; part at least of the rise in the cost of charcoal was due to the inability of local supplies to meet the demands of the expanding smelting industry in Furness.

This led certain companies to seek a guaranteed supply of charcoal by agreement with local wood owners, and the negotiation of such an agreement in 1748 appears to have been the initial reason for the expansion of the Furness industry into districts with better timber supplies (Fell (1908) 146-7, Awty (1957) 113). The cost differential between operations in Furness and Argyll cannot be precisely established, but the availability and cheapness of coalwood in the more remote areas was not a great advantage in terms of overall costs. High freight rates had to be considered; the use of Argyllshire coalwood in Furness was feasible only in certain conditions, and smelting in Argyllshire entailed additional costs in the shipping of ore and finished pig (below, 11.4). The main advantage of smelting in the Highlands was the possession of an assured supply of coalwood. Both companies working in Argyllshire after 1750 were able to base their operations on the use of coalwood purchased under contracts extending for sixty years or more, and Lorn Furnace at
least was able through most of its working life to obtain coalwood at prices fixed in the 1750s.

The site of Lorn Furnace was well chosen to offset some of the disadvantages of working in the Highlands. The position on the south-west coast reduced the sea journey necessary to reach Furness and the pig iron markets of the west coast, and the building of the furnace a short distance from a good anchorage on Loch Etive made overland haulage unnecessary. The site at Bonawe also gave access by sea to the coppice of a long and fragmented coastline; Bonawe was in addition the most suitable point for access to the extensive coppices of Loch Awe, the only major freshwater loch in the county. The company was therefore able to use water carriage to obtain coals from a large area (Fig.11.1).

There is unfortunately little evidence about the first few years of operation and the way in which the company dealt with the initial problems of smelting in the Highlands. Apart from the contracts of 1752 there is little information about the first thirty years, although the works was producing pig by 1762, when the Carron Company requested a supply for use in the forge (Campbell (1961) 50-1). Almost all the direct information available about the works is provided by a series of letterbooks for the period 1786-1813, at present housed in the National Library of Scotland (NLS MS.993-5). The furnace accounts and additional correspondence from 1780 onward, from which Fell
selected a few items of general interest, appear no longer to be accessible (Fell (1908) 395-411). Assessment of the costs and profitability of operations, as recently undertaken in relation to comparable furnaces in north Lancashire, is therefore not possible in the case of Lorn (Awty (1964) 19-38).

Although not systematic in providing information about the works, the letterbooks contain evidence about a wide range of relevant topics; the letters sent to the Newland management in Furness are especially valuable in indicating the company's true attitude to the use of Highland resources. The volume of letters written between August 1786 and January 1791 by James Longmire, manager during that period, is the most comprehensive and contains a large number of detailed letters to Matthew Harrison, the general manager at Newland (NLS MS.994). Later managers were less careful about copying letters; the volume used by John Harriman from January 1791 to April 1812 and thereafter by John Atkinson is less satisfactory. Letters to Newland were rarely copied in this period and there are several obvious breaks in the continuity of the sequence as a whole; no entries were made between August 1802 and April 1805, and there are fewer entries from that date until the end of 1807 than in the month of April 1789 alone (NLS MS.995). There is also a miscellaneous group of letters copied on loose sheets between 1791 and 1813, and now bound with the original contracts of 1752.
and later copies (NLS MS.993).

11.2 Organisation and administration

Lorn Furnace was owned throughout its operational life by the Newland Company, the title of which was derived, as was conventional in Furness, from the name of the original works owned by the partners. In 1752 the partners were Richard Ford and his son William, James Backhouse and Michael Knott; the Knotts later became major partners but in 1812 their interest was purchased by Matthew Harrison who had been manager since 1784 (Fell (1908) 270-4).

Organisational changes introduced by the new Newland partnership of Harrison, Ainslie and company may explain the termination of the Lorn records in 1813. The Newland company increased steadily in importance and achieved complete control of charcoal smelting in Furness by acquiring Backbarrow and Duddon works in 1818 and 1828 respectively; by 1873 the company owned five of the six charcoal furnaces in production in Britain (Griffiths (1873) 267, Fell (1908) 209, 216). Lorn Furnace was founded as the subsidiary of a minor company in one of the less important smelting districts, but ended as an integral part of the only domestic company serving what was by then a valuable and specialised market.

The full-time staff at Lorn Furnace was very small; under the manager or 'agent' were a wood agent and two or three assistants, the founder or furnacemaster and six or
seven labourers, one or more smiths and a carpenter.
During the summer the production of charcoal, bark and other material required several hundred persons, but none were full-time employees of the company (NSAS (1845) V.7 (Argyll) 100). The agent's responsibilities included negotiations with the owners of wood and the maintenance of cordial relations with the local community; he was also required to execute orders from Newland about the loading and unloading of vessels and had overall responsibility for coaling, the carriage of coals, and the running of the furnace. Major decisions on production at Lorn and the marketing of pig iron were made at Newland and this was undoubtedly an advantage, especially during the initial period of operation. Production at Lorn could thus be coordinated with that of the parent works according to the state of the market; the Newland management allocated pig from the different works to established customers and was in a better position than the Lorn agents to discover possible new markets. Until at least 1812, however, the autonomy of the Lorn agents was restricted not only in this field but in other matters which they may have been better placed to handle.

They were allowed a certain degree of discretion in following instructions given by the Newland management in routine matters; thus James Longmire, although authorised to give only a certain price for manufactured coals, took it upon himself to offer a higher price during a shortage
which had resulted in the premature blowing-out of the furnace (NLS MS.994, 36). In more important matters which could not be covered by general regulations, however, the agents were expected to obtain advice and directions from Newland. The implementation of major decisions was not generally taken out of the agent's hands, although some proprietors preferred to deal directly with the management, but any attempt to disregard or over-ride orders from Newland was not well received (NLS MS.994, 41, 77). The limited powers of the agent made it more difficult for him to deal with argumentative proprietors, balance the conflicting interests of his subordinates and handle the workforce.

James Longmire, already disturbed by the ease with which a disagreement with Campbell of Barcaldine which had occupied his attention since August 1786 was settled by Harrison during a brief visit to Lorn in July 1788, became increasingly concerned about his limited authority and offered to resign in January 1789; it is evident that Harrison had proposed some years before that the agent at Lorn should have greater power (NLS MS.994, 4, 59, 70). Longmire had been agent since 1781 and finally left the furnace and the employment of the company early in 1791; he was replaced by John Harriman (NLS MS.994, 121).

It is evident from Longmire's letters that he was dissatisfied with his position during much of his time at Lorn but Harriman, although given no greater authority in the
running of the concern, remained as agent for about twenty-two years without any evident sign of friction with his employers; it appears that the personality of the man appointed largely determined the ease with which he could adapt to working conditions at Lorn.

The post of wood agent (sometimes known as wood manager or wood surveyor) was regarded as important both in Furness and at Lorn, although subordinate to the agent. The wood agent was responsible for the upkeep of the company woods and the valuation of any other woodland before purchase; he advised the agent during negotiations and was occasionally given authority to bargain on the agent's behalf (Fell (1908) 138-40, NLS MS.994, 35). The wood agent assessed the quantity of coals likely to be available for the furnace in a given year; he recruited coalers, allocated work to them, and supervised them to ensure that quality was maintained and the terms of the contract followed (NLS MS.994, 64 MS.995, 23-4). As the Lorn wood agent was required to travel frequently his contract allowed him to reclaim all expenses incurred in this (NLS MS.994, 36). The post was more important than that of the agent in some ways, and was generally held by Furness men.

John Satterthwaite, the wood agent from the early 1780s until about 1801, threatened to leave in 1789 (NLS MS.994, 98, MS.995, 73); Longmire claimed that some of the woods were inspected only twice a year and thought that a local man might be employed as replacement if Harrison could not
find someone as willing as the previous wood agents to travel among the woods (NLS MS.994, 101).

The wood agent was generally assisted by two or three local men who were paid lower wages and entrusted with fewer responsibilities (NLS MS.994, 36). Although they occasionally assisted the wood agent in valuation they were employed mainly as stocktakers on the more remote coaling sites, checking the quantity and quality of the coals produced (NLS MS.994, 85-6). The founder's role was confined largely to matters directly concerning the operation of the furnace; he notified the agent of the quantity and type of ore required and requested replacements for items of furnace equipment which the smiths could not fabricate (NLS MS.994, 1-2, 15-16, 44). The smiths and carpenter were employed to work around the furnace; the smiths used bar iron, steel and mineral coal brought from Furness for repairs and replacements in the works; they also forged edged tools for the coalers and did a certain amount of unofficial casual work for the community as a whole (NLS MS. 994, 9, 21, 37, 42).

11.3 The furnace and fuel consumption

As already indicated Lorn furnace had no forge; a small amount of shot was cast but almost all the iron produced was exported in the form of pig, and any bar iron required for tools or other equipment was shipped from the
company forge at Newland (NLS MS.994, 65). Ore was imported from Furness in the company's ships and pig was dispatched, generally in the same vessels, according to instructions from Newland; the Furness trade maintained a system of supply in agreed quotas to established customers and the destination of Lorn pig was determined largely in relation to production at Newland and other furnaces in the district (Fell (1908) 311-12). In the period 1786-98 iron was sent mainly to a limited number of markets; most went to Chepstow in Monmouthshire but merchants in Neath, Cardiff, Newport and Newnham in Gloucestershire also used Lorn pig (NLS MS.994, 6, 25, 47, 75, MS.995, 13). Less regular cargoes were sent to other destinations farther north, including Carlisle, Liverpool, Chester and Ruabon (NLS MS.994, 19, 25, 33, MS.995, 65).

The annual production of the Lorn works was minute in comparison to present blast-furnace yields. Furnaces of the type in use in the Furness industry were capable of producing between six and eight hundred tons (610-813 t) of pig per year, although production levels fluctuated considerably. At Backbarrow between 1763 and 1780 the annual make varied from 321 tons (326 t) in 1770, obtained from a blast of only twenty-four weeks, to 862 tons (876 t) in 1779 when blast was maintained for a full year; the average annual make over the period was 608 tons (618 t) and the average make for the weeks when the furnace was in
blast was between fifteen and sixteen tons (15-16 t) (Awty (1964) 31-3). Production at Lorn appears to have been broadly similar. Consistent furnace accounts are not available but the official stated production in 1788 was 700 tons (711 t), and in a return made to a committee on the coal trade in 1796 production was stated as 600 tons (610 t); in 1839 the stated production of Lorn furnace was only 400 tons (406 t) (Mushet (1840) 421, Scrivenor (1854) 88, 97).

Letterbook entries provide what appears almost to be a complete record of the shipment of pig from the furnace during some years. In 1787 cargoes amounting to 593 tons (602 t) were shipped out, including unmarketable pig returned to Newland; the true total was perhaps 680 tons (691 t) or more, as a shipment in one of the company's largest vessels, which was generally loaded with eighty-five tons (86 t), was described but not quantified (NLS MS.994, 11, 15, 18, 20, 25-6, 33). 712 tons (728 t) were shipped for commercial use in 1791, and the true level of production may have been higher if unmarketable pig was returned to Newland (NLS MS.995, 1-6).

The weekly make varied through a blast and at its best was considerably higher than the average at Backbarrow; the yield was poor at the beginning of a blast and deteriorated toward the end, especially if the hearth required repairs. Production in late 1786 was not thought satisfactory at sixteen or seventeen tons (16-17 t) per week,
and this level continued into early 1787 (NLS MS. 994, 2, 5, 11). At the end of February 1787 the furnace produced eighteen tons (18 t) in a week for the first time since the blast started in 1786 and in April the weekly make rose to nineteen tons (19 t) of high-quality metal. By the middle of August production had declined considerably and at the end of that month was only fourteen tons (14 t) per week; the weekly make remained low until the furnace was blown out on September 22 (NLS MS. 994, 15, 22, 29, 31, 32, 34). The furnace was in blast throughout 1787, except for the period between September 22 and December 4; a weekly make of slightly more than sixteen tons is indicated if production during the forty-two weeks of blast was 680 tons (691 t) (NLS MS. 994, 34, 39).

In 1788 the furnace remained in blast through the year but only 700 tons (711 t) were produced, which indicates a weekly make of less than fourteen tons (14 t). The quality of the ore and charcoal was found deficient and the make was apparently exceptionally bad during the summer; in September Longmire estimated that production would be poor over the year as a whole (NLS MS. 994, 79-80, 44, 64). Production remained unsatisfactory in the following two years. The weekly make early in 1789 was again low and the furnace was blown out at the end of April; it was in blast again by early July after repairs to the hearth but performance later in the year was not outstanding (NLS MS. 994, 79-80, 81, 85, 87, 90). A shortage of charcoal made
it necessary to blow out again in late April of 1790 and the hearth was again found faulty; blast was apparently resumed at the beginning of July but additional repairs to the furnace were required in August (NLS MS. 994, 110-11, 114-15).

These examples indicate the irregularity of charcoal furnace operations, and the Backbarrow accounts provide further evidence of this; between 1763 and 1780 the overall average annual make was 608 tons (618 t), but production was within the range 558-658 tons (567-669 t), fifty tons (51 t) on either side of the average, only four times in the eighteen years (Awty (1964) 31-3). As even less information is available about production at Lorn there can be no certainty about the level of yield; it may be suggested, however, that the average level of production was between 650 and 700 tons (660-711 t). The furnace was capable of producing 988 tons (1,038 t) per year if a weekly make of nineteen tons (19 t) was maintained for a full year, but the combination of a poor weekly yield like that of 1788 and a forty-two week blast like that of 1787 would reduce production to little more than 560 tons (569 t); a blast of forty-two weeks was long by operating standards in Furness at the time (Awty (1964) 31-4).

A dozen consisted of twelve sacks of prescribed dimensions filled to a certain level with charcoal (NLS MS. 993, 4). Fell found that the charcoal requirements at
Backbarrow furnace rose from 1.54 dozens of coals per ton of pig in 1727 to 1.70 in 1747, 2.14 in 1778 and 2.82 dozens in 1800; he suggested that this could be explained by deterioration of the quality of charcoal in Furness (Fell (1908) 235-6). Consumption did not increase steadily. Awty later found that Backbarrow required an average of 2.14 dozens throughout the period 1763-80 without any appreciable rise toward the end of the period; at Pennybridge furnace the requirement in fact fell from 2.21 dozens during 1763-71 to 2.11 dozens in 1772-80 (Awty (1964) 37). In view of the similarity between Backbarrow and Lorn in tradition, working method and yield of metal, it may provisionally be assumed that Lorn furnace required 2.14 dozens per ton of pig during the same period.

A furnace using 2.14 dozens of charcoal per ton of iron would require 1,498 dozens per year to produce 700 tons (711 t) of iron. The wood agent at Lorn generally made a rough estimate of the quantity available for the coming season; in 1786 it was estimated that the 1787 season would yield 1,260 dozens and an additional quantity from the Lochnell lands. The first estimate for 1788 was 2,000 dozens and in March 1788 the total available during the summer was estimated as 2,000 to 2,100 dozens; it was thought then that 1,750 dozens would be available in 1789, but the total was later raised to 2,000 dozens (NLS MS.994 5,36,53,75).
These estimates are high in view of the quantity of iron produced and the general level of fuel consumption. It should be noted, however, that operating procedure was based not on adherence to an arithmetical average which might not be discernible from the pattern of production, but on the manufacture during the season of as much iron as the capacity of the furnace and the state of the market would allow; it is also evident that the agent of the time considered the final totals for the seasons 1788 and 1789 to be close to the maximum requirement of the furnace (NLS MS.994, 49). In addition it may be noted that if the furnace was working poorly and bad weather damaged a proportion of the coals before they could be housed the initial estimates became meaningless.

A certain degree of wastage was inevitable; charcoal dust and the small fragments known as brays were not suitable for use in the furnace (Aaistrick (1938-9) 59). Some of this small material was produced by the coaling process, especially if small timber and brushwood was used, but wastage was increased by the shipping of coals over relatively long distances; the type of vessel available for coal transport had an effect on the degree of breakage in transit (NLS MS.994, 80). The small material was not wasted; a certain amount was sent to Newland for use in the forges there, but more brays accumulated at times than could be used as backloading to Furness. In March 1789 a large quantity of brays was stored at the furnace and the
local proprietors were interested in purchasing them; by July of that year the quantity was even greater and the proprietors, who supposed that they were of no value to the company, were offended by Longmire's refusal to sell (NLS MS.994, 77, 90). It is therefore necessary to allow for a certain degree of wastage in coaling and shipping.

Baker has suggested that in the middle of the eighteenth century 250 cubic feet (7.0 cu. m) of small timber were required to make a dozen. He also concluded on the basis of experiment that a dozen weighed sixteen or seventeen hundredweight (812-863 kg); this is not dissimilar to Mushet's earlier statement that each sack weighed 1.5 hundredweight (76 kg), which indicates a weight of eighteen hundredweight (914 kg) per dozen (Baker (1943-5) 115, Mushet (1840) 65). The Scottish convention of measuring only the larger timber in volumetric terms prevents assessment of the yield of Highland coppice entirely in cubic or hoppus feet, but estimates are available which state yield partly in terms of weight and partly in volume. In 1824 Monteath published his estimates of the produce of Scottish oak coppice at a number of ages. He supposed that ten tons (10 t) of brushwood and 1,600 oak spokes would be available from an acre of oak coppice cut at twenty years, a cutting age common in Argyll (Monteath (1824) 261-3); the quantity of charcoal obtainable from timber is variable but a given amount of deciduous timber generally yields charcoal equivalent in weight to one sixth or more of the timber
Ten tons of small oak would in this case produce 1.66 tons of charcoal; if the average weight of a dozen is taken as seventeen hundredweight (863 kg), this charcoal would be equivalent to 1.95 dozens. Monteath found that 1,000 oak spokes could be obtained from sixty cubic feet (1.7 cu.m) of timber (Monteath (1824) 202-3); 1,600 oak spokes would therefore require ninety-six cubic feet (2.7 cu.m), and if 250 cubic feet were required to make a dozen of coals this would be equivalent to an additional 0.38 dozen. An acre (0.4 ha) of coppice would therefore yield approximately 2.33 dozens in total, rather more than the amount required to produce a ton of pig.

To allow for an element of wastage it might be assumed that one acre (0.4 ha) of coppice was the exact area required to produce a ton of iron; an annual production of 700 tons (711 t) would therefore require 700 acres (283 ha) of coppice and a furnace with this capacity would need 14,000 acres (6,075 ha) on a twenty-year rotation to maintain continuous production. It is possible that requirements at Lorn were considerably lower. Inspection of the Newland accounts led Fell to state that Lorn Furnace, with a better source of charcoal, used only 1.71 dozens per ton at a time when Newland furnace required 2.33 dozens (Fell (1908) 396). If it is assumed that this was correct, that an area of highland coppice produced 2.33 dozens of charcoal without wastage, and that production at Lorn Furnace
was on average only 608 tons (618 t), equivalent to that of Backbarrow in the late eighteenth century, 1,040 dozens would be required per annum and could be obtained from 446 acres (181 ha); 8,920 acres (3,613 ha) on a twenty-year rotation would therefore be necessary for continuous production.

Lower estimates have been made; factors of critical importance in affecting calculation are the timber yield of coppice, the quantity of timber required per dozen, and the number of dozens required per ton of pig iron. Before 1840 Mushet calculated that if an acre of coppice produced 1,200 cubic feet (34 cu.m) of timber, which he regarded as a low yield, a charcoal furnace producing 1,000 tons (1,016 t) per year would require 120 acres (49 ha) per annum, and therefore 1,400 acres (567 ha) on an eighteen year rotation. It should be noted that this estimated total is affected by an arithmetical error and that the correct total in these terms would be 2,160 acres (875 ha). All Mushet's terms were more favourable than those already used. If 250 cubic feet (7.0 cu.m) of timber produced a dozen of coals, Monteath's estimate suggests a yield of less than 600 cubic feet (17 cu.m) at twenty years; Mushet assumed a yield of 1,200 cubic feet at eighteen years and it is also evident from his calculations that he took 107 cubic feet (3.0 cu.m) as sufficient to produce a dozen. He also assumed that 1.33 dozens would be required per ton, which is considerably less than known fuel consumption in the Furness-

If the calculation set out by Mushet is adapted to suit a furnace producing 700 tons (711 t) per year at 2.14 dozens per ton, 134 acres (55 ha) would be required per year, or 2,680 acres (1,085 ha) on a twenty-year rotation (Mushet (1840) 407). If Baker's estimate of 250 cubic feet (7.0 cu.m) of timber per dozen of charcoal is taken with Mushet's estimated coppice yield of 1,200 cubic feet (34 cu.m) per acre, 4.80 dozens would be available per acre, in comparison to the original estimate of 2.33 dozens derived from Monteath's estimates; a furnace producing 700 tons per annum and using 2.14 dozens per ton would in such a case require 299 acres (121 ha) per annum and 5,980 acres (2,422 ha) on a twenty-year rotation. There is therefore considerable scope for variation in estimates, although more definite knowledge of the yield of Highland coppice would allow more consistent calculation. The estimate of 14,000 acres (6,075 ha) is by far the largest; as it is based on an exceptionally low estimate of yield per acre and contains a generous allowance for wastage it is almost certainly an over-estimate. Mushet's calculation is likely to be a considerable under-estimate, even after amendment, and it may be suggested that Lorn Furnace required between 6,000 and 10,000 acres (2,430-4,050 ha) of coppice on a twenty-year rotation. Even if the produce of 14,000 acres was required, this is equivalent only to 27.8 per cent of the area within a circle of five miles (8.0 km) radius or the total area within 2.63 miles (4.23 km) of a given point;
it would therefore theoretically be possible for a furnace of equivalent size built within an area of continuous woodland to operate indefinitely by using charcoal available within less than three miles (4.8 km) of the furnace site. 14,000 acres or 21.88 square miles is equivalent only to 0.70 per cent of the area of Argyllshire or 0.28 per cent of the area in Scotland described as natural woodland in the first census of woods and forests in 1812 (Anderson (1967) V.2, 187).

It should be emphasised that these calculations serve only to give a broad indication of the requirements of Lorn Furnace. Even if the coalwood yield of Highland coppice and the amount of timber required to make a dozen of charcoal could be established with some certainty, variation in the annual make of iron and the quantity of coals required to produce a ton of pig was large enough to ensure that the quantity of coals used changed greatly from year to year. The estimates do, however, give an approximate indication of the requirements of Lorn Furnace and show that a works making use of coppice wood could remain in operation with limited resources; if attention was paid to the management of coppice and the restocking of sections which showed signs of exhaustion a charcoal furnace could be fuelled indefinitely from relatively small woods within a short distance of the site. This was indeed frequently necessary; the poor quality of the British road system before the late eighteenth
century and the high carriage costs of timber and coals in relation to value restricted the distance within which a furnace could obtain coals at economic rates (Hammersley (1957) 156); thus the furnaces of south Yorkshire in the first half of the eighteenth century used only charcoal available within ten miles (16 km) of the furnace site, and about sixty per cent of the purchases were within five miles (8.0 km); the area available to the ten furnaces and ten forges operating in the district during the period was not notably well-wooded (Raistrick (1933-9) 54, 57, 60, 69).

11.4 The charcoal supply

It has already been noted that in Argyllshire as in other smelting areas coppice was the basic source of coal-wood (above, 1.5, 8.4); coppicing was the management system most capable of meeting the iron industry's demand for an assured, continuous, but flexible supply of charcoal. A guaranteed source was necessary to obviate the necessity of finding a new supply at short notice for each year of operation. Continuous production of charcoal in quantities sufficient to fuel the furnace was preferable to storage of the produce of large intermittent purchases; charcoal was perishable and too bulky to be stored easily in large quantities. For similar reasons it was necessary that the supply should be flexible enough to be adapted to change in factors affecting consumption; charcoal requirements
varied from year to year in accordance with the efficiency of furnace operation and the state of the market. Fluctuation in the working of charcoal furnaces has already been noted (above, 11.3); extra production might be desirable in some years but at other times depressions in the market for iron led to the curtailment of blast or blowing out. This was especially likely in a case like Lorn, which was the subsidiary of a major producing unit.

Lorn Furnace obtained an assured supply of coalwood coppice under a series of contracts made in 1752 with Sir Duncan Campbell of Lochnell, the proprietor of the furnace site, and the second earl of Breadalbane (NLS MS.993, 1-33). In the first of two contracts with Lochnell, both signed at Inveraray on September 30 1752, the company was initially sold the woods of Muckairn parish and Lochnell's lands in other parishes, with some reservations, for a period of fourteen years from August 1 1753; payment was to be £1,500 sterling in ten annual instalments. When this contract expired in 1767 a ninety-six year lease of the charcoal of these woods, excluding those of Muckairn, was to come into force. Under the second lease the company was allowed to coal all the timber except oak and that of certain reserved areas; the woods were to be cut over only twice during each forty-eight years of the lease or four times in all. Lochnell himself was to have the oak cut and he retained the bark; the oak of any one section was to be cut in the summer following the cutting of the barren
or winter timber of the same wood. The peeled oak timber was to be available for coaling by the company, but Lochnell was not obliged to cut the oak until it was twenty years old. Under this lease payment was 3/0d sterling per dozen of charcoal in the first forty-eight years and 3/6d in the second; the measures to be employed and the methods of accounting for the delivery of charcoal were carefully recorded (NLS MS. 993, 1-4).

The second contract of the same date consisted of a tack of most of the lands of Muckairn parish and their woods for 110 years. A small area including the lands of Kirkton (now Taynuilt) and Ichrachan in Inishail parish, on which the furnace was to be built, was set in tack for 110 years from Whitsunday 1753 and most of the lands in Muckairn parish were leased for 106 years from Whitsunday 1757; the woods of the lands were leased for ninety-six years from August 1 1767, when the initial fourteen-year contract expired (NLS MS. 993, 25-32). The contract therefore provided a furnace site and the lands and woods of the major part of Muckairn parish until 1863; the only major stipulations about the use of the woods were that the enclosures should be maintained and that 1,000 oak standards reserved from the fourteen-year contract should remain Lochnell's property. Annual payment for use of the woods during the period of the tack was £100 sterling (NLS MS. 993, 28-32). Figure 11.1 indicates the distribution of these lands; the two contracts together provided the com-
Based on NLS MS 993.

Figure 11.1. The location of Lorn Furnace.
pany with the long-term tenancy of the most compact and best-wooded part of Lochnell's lands, with an additional supply from the more dispersed and poorly-wooded lands over the same period (Fig.11.1).

The two contracts with the earl of Breadalbane, both signed at Taymouth on October 4 1752, were similar in terms to the first contract with Lochnell. In the first, which is no longer extant but is summarised in the preamble to the second, the woods of Breadalbane's lands on the upper part of Loch Etive, the twenty-seven mark land on Loch Awe, and other lands on the same loch were sold for a period of ten years from Michaelmas 1753 (Fig.11.1). In the second contract Breadalbane obliged himself to deliver the charcoal produced by these woods to the furnace at Bonawe; the woods were to be divided into ten parcels or hags and cut over in two eleven-year periods starting in the winters of 1776 and 1800 respectively; cutting was to start in early winter in any season and the delivery of charcoal was to start on March 5 in the following year. The company was obliged to accept delivery of the charcoal, and to pay 18/0d per dozen; the measures and receipting system to be employed were again carefully defined (NLs MS. 993, 8-14).

The terms of these contracts were extremely favourable, especially when the value of coppice produce increased greatly at the end of the eighteenth century. In 1824
Monteath estimated that a proprietor with at least 100 acres of rotated coppice could expect an annual rent of £2-6s per acre (Monteath (1824) 28). Even at only £2 per acre the annual rent of the Muckairn woods was equivalent to the value of only fifty acres (20 ha), but as shall be seen later the parish contained at least 1,900 acres (770 ha) of coppiced wood (below, 11.8). The sum charged as wood-leave for production of charcoal on the other Lochnell lands was also small; wood-leave of 8/6d per dozen was common in Furness by the early eighteenth century but the company still paid only 3/0d per dozen for coalwood on the Lochnell lands in 1809 (NLS MS.995, 80, Fell (1908) 130). It is not surprising that the factor appointed in 1786 complained that the tack was disadvantageous to Sir Duncan Campbell's son, to whom the estate had passed between 1760 and 1770 (NLS MS.994, 15).

The price of £8/0d per dozen for coals delivered to the furnace from the Breadalbane lands was very low; the delivered price in Furness was as high as 28/6d in 1715 and prices there were in general between 38/0d and 40/0d in the late eighteenth century (Awty (1964) 37). The price of manufactured coals delivered to Lorn Furnace from other lands rose from 27/0d in 1737 to 34/0d in 1796, shortly before the start of the second cutting under the Breadalbane contract (NLS MS.994, 36, MS.995, 58).

It is possible that these contracts were originally intended to supply sufficient charcoal to meet the needs
of the furnace entirely; if this was so the idea had been abandoned by the 1780s, when much of the demand was met by coals purchased under supplementary contracts for shorter periods. The twenty-four year cutting period prescribed for the Lochnell lands outside Muckairn was followed in broad terms; thus woods cut in 1787 and 1788 were again scheduled for cutting in 1812 and 1813 respectively, twenty-five seasons after the previous cuttings (NLS MS. 994, 9, 36, MS.995, 86, MS.993, 68). It is evident, however, that the woods were not cut in a strict rotation of sections or hags of equal size. In 1787 200 dozens were expected from the cutting of woods in Glenkinglass, part of the area on the ninety-six year charcoal lease; Lochnell wished the cutting of one section to be deferred and this had led to some rearrangement (NLS MS.994, 9). In 1788 400 dozens were expected from another section of the woods outside Muckairn; in the initial estimate for the following season only fifty dozen were expected from Lochnell's lands but by February 1789 an additional 250 dozens from Clais Dhearg in Muckairn had been added. In 1790 Longmire arranged for the cutting of the rest of Clais Dhearg, although he expected to meet objections from Harrison in Newland (NLS MS.994, 36,53,75,105).

The primary advantage of regular rotation was that the proprietor's income from woods was evenly distributed and such a scheme could be disregarded if flexibility was important; the cutting of woods normally coaled every
nineteen years could be delayed, if necessary, for an additional period of five or six years during which the quality of bark and timber improved. The Lochnell woods appear to have met no more than twenty-five per cent of the requirements of the furnace and the purchase of additional coalwood was very important. Large areas of coppice came on the market irregularly, and if several became fit for cutting within a short space of time the company could not expect proprietors to withhold them from sale until a more suitable time. The threat of competition was small but was utilised by landowners determined to make as large a profit as possible from their woods as soon as the timber was fit for use. Thus when a large wood on Loch Craignish was offered to the company early in 1788 Longmire, who already had charcoal sufficient for two years under contract, asked that it should be reserved from sale for two years; when it became evident that the proprietor was determined to find a purchaser immediately Longmire thought it necessary to make an offer for it despite the adequacy of the assured supply (NLS MS.994, 49, 52). At other times external supplies did not provide sufficient charcoal; thus Longmire ordered the coaling of Clais Dhearg against Harrison’s wishes in 1790 in an unsuccessful attempt to keep the furnace in blast (NLS MS.994, 105). This indicates the company’s reasons for not employing a strict rotation in its own woods; if managed on a flexible system they could be reserved when the external supply was adequate and utilised when short-term contracts proved insufficient.
Figure 11.2. Lorn Furnace; supplementary contracts, 1786-1810.
Most of the supplementary contracts were for periods of one to three years, although some extended to seven or eight years and a few winter timber contracts lasted only for a single winter. Payment varied accordingly; as little as £30 was paid for a small area of black wood but when the extensive Barcaldine woods, previously cut between 1782 and 1789, were bought under two separate contracts in 1808, the total payment for each year's cutting was £1,491 (NLS MS.994, 74, MS.995, 79,81). Almost all contracts took the form of a simple purchase of standing wood; Lord Berners offered a tack of lands with his woods on West Loch Tarbert in 1794 but the company was not interested (NLS MS.995, 37). In some cases the company was offered the coalwood of coppice by proprietors who reserved the bark for their own use, or by timber merchants interested in the measurable wood. The coppices bought by the company were dispersed through coastal Argyllshire; the availability of water carriage allowed access to the woodland of a wide area, and as is evident from Figure 11.2 some of the woods bought between 1786 and 1813 were almost fifty miles (80 km) from the furnace in linear terms, and considerably farther by water (Fig. 11.2).

Most of the proprietors of lands around Loch Etive sold timber to the company at one time or other, and they frequently informed the furnace agents about the availability of coppice in more distant areas. The agents were able to make use of the proprietors' local knowledge in
assessing the potential of a purchase, and the ties of kinship and friendship were also utilised in communication with landowners in other districts. Thus in the first few months of 1787 the furnace agent approached McLain of Lochbuie in Mull through his father-in-law, Campbell of Airds, while Lochbuie relayed messages to the company through Campbell of Sonachan. Airds himself had woods to sell but bargaining had reached deadlock; Campbell of Sonachan and John Gardner at Inverawe advised the agent about his intentions and the possibility of competition. At the same time Sonachan, Gardner, and Stewart of Fasnacloich were providing information, advice, and aid as intermediaries in negotiations for the woods of Callart on Loch Leven (NLS MS.994, 18, 20).

This network of local ties was not always adequate to inform the agents about woods more remote from the furnace. In some cases the agents solicited information; when paying the last instalment of the price of the duke of Argyll's woods in Morvern in 1790 Longmire asked the Argyll factor whether the duke had any other woods suitable for cutting (NLS MS.994, 113). At other times the initiative was taken by proprietors who regarded the company as the most suitable customer. J.M. Riddell informed the agent of his father's intention of selling woods in Ardnamurchan and Sunart in 1789 by letter, and as already indicated Lord Berners wrote offering a tack of lands and woods on West Loch Tarbert in 1795 (NLS MS.994, 77, MS.995, 37).
In a few instances the agents were first informed of the availability of coalwood by newspaper advertisements; thus an advertisement in the Glasgow press in 1798 led Harriman to contact Lord Stonefield about his woods on West Loch Tarbert (NLS MS.995, 69).

In Argyllshire coppice was generally bought either by private bargaining or by auction. The process of private bargaining began with the valuation of the woods on offer; this was generally done by the company wood agent after contact with the owner, although in the case of small woods or coppices exactly described in advertisements the valuation was sometimes made before the company made contact with the proprietor (NLS MS.995, 9, 25). The company then started negotiations with the proprietor, his factor or attorney; in some cases a neighbour or kinsman was authorised to intromit with a proprietor's affairs during minority or absence (NLS MS.993, 54-5, MS.994, 75, MS.995, 66). The vendor was generally expected to make his price known before the company made an offer, although the agents dispensed with this formality in cases of urgency (NLS MS.993, 61). From that point onward the parties generally moved toward agreement; in some instances the vendor communicated directly with the Newland management but more often the agent conducted negotiations on instructions from Newland, and in minor purchases the wood agent was authorised to bargain on his behalf (NLS MS.994, 35, 104, 119). Formal contracts were drawn up in a few cases but in general
acceptance of the company's written offer appears to have been regarded as sufficient to seal the agreement; thus when the company bought Lochbuie's woods in 1789 the parties agreed that a contract was not necessary (NLS MS. 994, 100, 115-16).

Negotiations were frequently protracted and complicated; on occasions they broke down and the woods were offered for sale by auction. Thus Lochbuie was interested in selling his woods in 1785 but they were not inspected until 1787; formal valuation took place in the following year and after some confusion over the area which he intended to sell agreement was finally reached in December 1789 (NLS MS.994, 34, 79, 97, 100). Late in April 1794 Harriman wrote to Hector Buchanan, a writer in Edinburgh who was authorised to sell woods in Moidart and Arisaig belonging to Macdonald of Clanranald; he advised Buchanan and Clanranald in separate letters that the company would be interested only if a less valuable substitute was found for the area of woodland reserved for the use of the tenants, which inspection showed to be of some value. This advice was accepted and by September it had been agreed that both parties were willing to bargain privately. Buchanan therefore stated a price of £2,500, which was so far above the £1,000 which Harrison had authorised Harriman to pay that he abandoned negotiations and arranged to send the wood agent to a roup of the woods advertised as taking place on October 24. No other prospective purchaser
appeared at the auction, but the asking price was still too high; after further consultation with Harrison the agent offered £1,600, and Buchanan agreed to this offer in mid-November (NLS MS.995, 25-6, 31-5).

As this example indicates the company was generally unwilling to purchase woods by auction if private negotiation was possible. Competitive bidding raised the price of woods and the purchaser was required to conform to articles of sale which were not necessarily framed to suit the company's interests. Although the agent was able to obtain additional privileges in at least one case where the company bought woods by auction, private bargaining allowed a greater degree of flexibility (NLS MS.995, 16). The company was frequently able to bargain privately in cases when the proprietor preferred to have his timber auctioned; competition was limited and the company was therefore in a good bargaining position. Thus in the sale of the woods in Arisaig and Moldart the agent was able to alter the conditions of sale and obtain the timber at a price lower than might have been expected if the roup had been well-attended. In a number of cases the agent was able to purchase by private agreement when the proprietor realised that the demand for his timber was very limited.

Thus Patrick Campbell of Ardchattan announced in the Glasgow press that his woods were to be rouped at Bonawe on February 16 1789; the woods lay within three miles (4.8 km) of Lorn Quay by water and the company was therefore
well-placed to offer a high price, but Ardchattan seems to have been determined to force the price up as much as possible. The February sale was postponed until March 18 to let intending customers be present, but on the day only Campbell of Sonachan and the company agents attended and another sale was arranged for April. The agent did not attend on this occasion and only a merchant from Oban and two Glasgow men appeared. Ardchattan steadfastly refused to bargain with the company and Longmire was content to wait until Ardchattan's patience was exhausted. At a final abortive roup in August 1789 the price was set so high that no bids were made; Ardchattan finally conceded defeat and sold the woods to the company by private agreement in August 1790 (NLs MS.994, 70-1, 73, 77-9, 88, 90, 115).

The earl of Breadalbane's factors found difficulty in selling the second cutting of the woods from which the company was to be supplied with charcoal under the agreement of 1752. The company made reasonable offers for the bark and coalwood together but the woods were advertised for sale in terms which acknowledged the commitment under the contract in 1797, 1799 and 1800. These attempts to raise the price of bark failed and Breadalbane himself was obliged to undertake the coaling of the woods to fulfil the contract; early in 1801 he accepted the company's last offer to cut the remaining woods (NLs MS.993, 43, 54-5, 62, MS.995, 71, Anderson (1967) V.2, 85). In some cases
advertisement of the sale of wood was little more than a weapon in negotiations with the company. Thus Lochbuie arranged a roup when the agent showed little interest in the woods, but later cancelled it and offered to bargain privately (NLS MS.994, 76, 83). Longmire refused to consider the Riddell woods in Ardnamurchan and Sunart in 1790 as they were too young to be cut; the factor consequently warned him that the woods would be advertised in the following year, but although other parties showed some interest during 1790 the woods were not sold until 1795 (NLS MS.994, 103, 105).

The owners of woods were therefore not in as strong a position as those in other parts of the Highland fringe; the strength of the existing market appears to be one reason for the retention of contracts covering several years in Argyllshire at a time when annual roups had become common elsewhere (above, 8.5). The poor attendance at roups was in marked contrast to Furness, where auctions were keenly contested and attracted a considerable amount of local interest (Fell (1908) 140-2). The two iron companies provided the only consistent commercial market for the small timber of the county and as shall be seen later the interest of the Lorn management in bark and timber made the company the largest single user of coppice produce in north Argyllshire. It was generally agreed by contemporary observers that the presence of the two ironworks in the county had raised the value of woods, but in 1805 Smith
qualified his praise by noting that prices could have been higher; the long leases of some woods and the absence of serious competition for others allowed the iron companies to impose a measure of control (OSAS V.5 (1793) 298n, Smith (1805) 137-8, Walker (1812) V.2, 208, Singers (1829) 139, Smith (1835) 8).

The owners of woodland could not therefore expect to take advantage of competition in the market for coalwood. The iron companies maintained an informal agreement about the allocation of woodland; when Longmire arrived as agent at Lorn in 1781 he was instructed to visit Joseph Latham, the manager of Argyle Furnace, for advice about the mutual interests of the two concerns (Fell (1908) 410). The Lorn sphere of interest included north Argyllshire and the Atlantic coast at least as far as Knapsdale, while Argyle Furnace used wood from Cowal and Loch Fyne; these areas of interest were separated by treeless upland except on Loch Awe, where Lorn appears to have worked on the north shore and left woods on the south shore largely to Argyle Furnace (OSAS V.6 (1793) 269). The companies generally remained on good terms; on a visit to Argyle Furnace in 1787 Longmire lent Latham a company wood agent for a few weeks to replace the Argyle agent, who had died shortly before, and he was assured that the Argyle management would attend to the interests of Lorn at all times (NLS MS.994, 31-2).

Early in 1789 a small proprietor on the north shore of Loch Awe, believing that the company under-valued his woods, tried to sell them to Argyle Furnace; Latham duly informed
Longmire about this and the woods were bought by Lorn in the following month (NLS MS.994, 73, 75). Most proprietors appear to have been aware of such an agreement, however, and made no attempt to arouse rivalry between the companies.

There was a very limited demand for charcoal from other users based in northwest England; the cost of carriage was generally too high to make the export of charcoal feasible. Newland company vessels returned with brays and coals after delivering ore to Lorn, and Longmire anticipated that the wood available at Loch Craignish in 1788 would be suitable for this purpose as it lay on the homeward route; he refused to consider the possibility of sending vessels in ballast from Furness specifically to collect it (NLS MS.994, 42, 49). In 1794 Harriman sold brays to a company in Cumberland and offered to put them on board a vessel which would carry them from Bonawe at 20/0d per dozen (NLS MS.995, 31). Such a freight rate was more than equal to the difference between the costs of manufactured coals in Argyll and Furness. Highland charcoal was therefore of little interest to regular charcoal users with no other reason to send vessels to the Highlands, but in 1781 the three major Furness companies entered a formal agreement to apportion equally all the charcoal made in Lancashire, Cumberland and Westmorland; coordination of their interests in this way made it exceptionally difficult for other local users to obtain a cheap
and regular supply (Fell (1908) 142-3).

The less powerful companies of northwest England therefore were forced to find alternative sources of supply. Campbell of Airds refused to sell charcoal delivered at Lorn Quay and was able to sell his coals to Cumberland in 1788. The price was at least 42/0d and indicates that small users were willing to pay high prices; the freight rate of 11/0d per dozen was exceptionally low (NLS MS.994, 73). Airds' coals may have been bought by Spedding, Hicks and company, the owners of a furnace near Workington, who were said in 1790 to be interested in the Riddell woods of north Argyllshire; Sir James Riddell was still interested in the possibility of shipping coals to England in 1795 (NLS MS.994, 105, MS.995, 57, Fell (1908) 36, 290-1). The level of freight rates must have been critical, however, and there appears to have been little demand from this source.

Timber and bark merchants provided a more regular and significant form of competition; they had no direct interest in small timber and were therefore prepared to sell the coalwood or manufactured coals to the company. Only a few merchants were active in Argyllshire at any one time; at the end of the century the most prominent were James Turner and Peter McLachlan, both residents of Dunbartonshire. In 1792 they were partners in the purchase of woods in Appin from which they offered the company charcoal; Turner supplied coals in 1795 from this or another purchase in
Appin (NLS MS.995, 10-11, 63-4). Turner, McLachlan and Latham of Argyle Furnace were the bidders at roups of coniferous plantation and coppice in Glendaruel in Cowal early in 1792; McLachlan bought the plantation and Latham purchased the coppice (SRO GD.1/390 (53, 54)). McLachlan also bought coppice on Loch Melfort for which the company had bargained unsuccessfully in 1795; he and his son offered the company coals from Loch Welfort in the two following seasons (NLS MS.995, 38, 60, 65, 67).

Turner was able to supply coals from Taynish in Knapdale in 1806 and 1807, and in the latter year charcoal was again offered from Loch Melfort by William McMurrich, a Glasgow timber merchant (NLS MS.995, 76-7). Members of the Stevenson family, which had a significant part in the early development of the town of Oban, also purchased timber (OSAS V.11 (1794) 135, Garnett (1800) V.1, 141). John Stevenson arranged the sale of Airds' coals to Cumberland, attended roups, and at least once was able to obtain a small wood which the company had considered buying (NLS MS.994, 34, 36, 70, 79). In 1796 Thomas Stevenson sold the company coals from part of the Lochnell lands excluded from the contracts of 1752 and in the same year he was involved in the bargaining over the coals of the Kiddell woods in Sunart (NLS MS.995, 55-6, 61). Hugh Stevenson founded a tannery in Oban in 1790 and purchased bark for it regularly from the company (NLS MS.994, 117, MS.995, 8, 54, 67).
It cannot be said definitely that competition for coppice had a significant effect on the supply available to the company; smelting remained the most valuable market for the small timber of Argyllshire coppice. The price which the company was willing to pay for manufactured charcoal rose, however, from 27/0d in 1787 to 34/0d in 1796 (NLS MS.994, 14, MS.995, 58). In 1812 Walker suggested that a dozen of coals of oak was worth 36/6d delivered (Walker (1812) V.2, 287). Charcoal prices therefore seem to have been affected by the general increase in the value of coppice produce at the end of the eighteenth century, although in proportionate terms the increase in prices is much less striking than in the case of bark (above, 8.3).

11.5 Cutting, coaling, and carriage

When an area of coppice had been purchased the wood agent divided it into sections for cutting and coaling; he and his assistants then were responsible for the organisation and inspection of cutting, coaling, and the delivery of coals to the furnace. The company's cutting method was simple; the first Lochnell contract of 1752 required that cutting should begin at one or both sides of the chosen wood and continue until all the suitable timber had been felled (NLS MS.993, 2). This was a good policy both in coppice management and felling; it ensured that the timber of a defined area of woodland was cut within a short
period and would therefore grow uniformly after enclosure. It was also more efficient than selective felling as a means of collecting timber for coaling; the management was aware of the inconvenience and extra cost of cutting trees scattered through an area of woodland and assembling them at certain points for coaling (NLS MS.995, 11).

This form of systematic clearing alarmed some proprietors to whom it was unfamiliar; Macdonald of Traigh objected to the company's men cutting and clearing all before them, to which Harriman replied that it was the company custom to cut every useful form of timber unless specifically reserved (NLS MS.995, 29).

Measurable timber was usually reserved from sale; it was generally sold as whole timber when available among coalwood bought by the company, being too valuable and often too large to be efficiently coaled (Reynolds (1961) 4). Thus during the cutting of woods on Loch Awe Longmire informed Lochnell's commissioner that forty unreserved oaks were too good to be coaled; the terms of the contract did not permit the sale of oak timber but he and his wood agent preferred to sell the trees as timber on Lochnell's behalf rather than waste them in coaling (NLS MS.994, 86-7).

The company was also reluctant to cut brushwood and scrub. When making an offer for wood the agent in some cases stated that 'scrogs' or brushwood would not be cut unless thought suitable (NLS MS.995, 38); when Stewart of Fasnacloich decided to increase the amount of timber reserved from sale
in an area of barren wood in 1789, Longmire claimed that the company would thus be confined to 'scragging' or cutting all the small timber and was unwilling to let this happen (NLS MS.994, 102). A number of contracts allowed the company discretion to cut what was regarded as suitable; this was the case in the Lochnell contract of 1752 and when the duke of Argyll had a wood in Morvern inspected in 1789 the density of brushwood was attributed to the fact that in the agreement the company had not been bound to take it during cutting (NLS MS.993, 2, Cregeen, ed. (1964) 165). Although brushwood was not always cut, deliberate reservation by the proprietor was inconvenient; Macdonald of Traigh tried to reserve hazel, but was told that this would cause more trouble to the cutters than the value of the timber justified (NLS MS.995, 11).

Almost all species were coaled by the company if the trees were of suitable dimensions. Coniferous charcoal was not used and a clause in the second Breadalbane contract allowed the company to refuse coals made of pine timber (NLS MS.993, 13). There is no evidence that any one deciduous species was preferred or avoided in coaling. As in other parts of the Highlands the distinction between oak and barren timber was recognised, but the nature of the company's operations led to a modification of this convention. Furnace operation required a steady supply of charcoal during the blast, but the company also had an interest in the sale of bark from oakwood; it was there-
fore desirable that woodland in which oak was prominent should be cut and stripped during the summer. The company applied a system, which appeared to be derived from Furness practice, in which the oak was cut in summer and areas of barren wood were left to be cut as 'winter wood' or 'winter timber'. Winter timber was defined quite simply in the first Lochnell contract as including all timber or wood except oak; in practice ash and other species reserved by proprietors as timber trees were also at times excluded from the sale of winter timber (NL5 MS. 994, 102, MS.995, 15, 38).

The requirements of the bark trade therefore made it necessary to cut coalwood in two distinct seasons, and adjustment of cutting during these seasons to ensure an even supply of charcoal was a continual problem. It was most convenient for the company to purchase coppice which contained distinct areas of oak and winter wood; arrangements for the movement of coalers and the carriage of coals were easier in such a case and most of the purchases of wood remote from the furnace took this form. The difficulty of deploying a limited number of skilled master coalers also made it desirable that the woods cut during one season should be relatively compact and confined to a few districts. A major reason for the company's lack of interest in Lochbuie's woods in Mull was that they were located on three farms separated by distances of five miles (8.0 km) or more (NL5 MS.994, 34, 84); the agents occasionally
offered higher prices for timber available near the sites on which the coalers were already working (NLS MS. 994, 72, MS.995, 14). Small areas of winter timber bought by the company were generally easily accessible from the furnace, although an offer was made in 1805 for a large amount of barren timber on Loch Leven and upper Loch Linnhe about thirty miles (48 km) distant by water (NLS MS.995, 14).

The company regarded Martinmas (November 11) as the start of the coaling year. The winter timber of a purchase was therefore cut and coaled first and the oak was cut in the following summer; this continued for the number of seasons specified in the agreement, and although in some cases the wood was to be cut and cleared within a year, the company generally expected an additional period, usually six months, to clear the ground at the termination of the more remote purchases (NLS MS.994, 56, 101, MS.995, 15, 38). The winter cutting season was defined in the Lochnell contract of 1752 as extending from September 1 to April 1, but cutting almost invariably began in November and the season also generally seems to have ended later than April 1. In some instances it was agreed that the company should cut barren timber by that date but in others the agents wished to follow the customary Furness date of April 26 (April 15 Old Style), or to cut timber as late as April 30 (NLS MS.994, 45, MS.995, 38, 49).

Cutting generally started late in the winter season.
In 1788 only sufficient timber for twenty dozen had been cut before the end of November by a single coaling team; by early January the team had cut 100 dozens but the others were not expected to start before the customary coalers' holiday of old new year's day in the middle of the month (NLS MS.994, 67, 70). Cutting and coaling could have been carried out earlier in the season but the carriage of coals was dependent on a supply of feed for the horses; natural grass was not generally available before the beginning of April and although the company kept much of the tack lands of Muckairn under hay it was not always possible to ensure that a supply reached horses on the more remote sites in early spring (NLS MS.994, 109).

There was therefore generally little advantage in cutting and coaling before the produce could be carried to the shore in spring, although in 1789 coaling began at Barcaldine, a few miles from the furnace, in early December (NLS MS.994, 100). Small areas of winter timber were purchased quite late in the season; in 1789 two small woods were bought and set for coaling as late as February 24 (NLS MS.994, 75). In 1787 the coaling of winter wood was almost complete by March 9; in 1789 most of the coalers had finished by late March but bad weather delayed work at Callart and coals had still not arrived by mid-April (NLS MS. 994, 16, 77, 79). In 1790 horses were sent to load coals at Callart and in Morvern at the end of March but coaling did not start at Clais Dhearg in Muckairn until April 14; coals were available from this
site by April 23 but the first shipment from Callart, where the horses had arrived before the boatload of fodder, had not arrived by that date (NLS MS.994, 108-10). Little or no timber was produced in most years between November and the middle of March, and transport difficulties could prevent an adequate supply reaching the furnace before the end of April (NLS MS.994, 81).

The summer season was in general similar to the oak stripping season in other parts of the Highlands, although the stripping of oak continued until the end of July (NLS MS.995, 38, 49). Cutting of oak began toward the end of May and in some seasons was largely complete by early July (NLS MS.994, 88, 113). The first coals of the summer could be available as early as the second week of June; in 1787 they had arrived by June 13 and in 1788 they were expected no later than June 11. In 1789, however, the carriers and horses had not been sent out to the Morvern site by June 8 (NLS MS.994, 26, 57, 85). In good seasons coaling was completed by September or early October. In 1786 some of the coalers had finished by September 25, although the coalers in Morvern were still at work at the end of October; in 1787 coaling had finished in Glenkinglass by September 6 and was well advanced elsewhere (NLS MS.994, 5-6, 32). In 1788 most coalers had finished by September 10, but some continued at Rubha Garbh-Aird on the Lochnell lands until early November, when coaling on the site was stopped until spring. In some seasons the
Lochnell woods were coaled late in the year, perhaps when teams could be spared from other districts; in 1790 coaling started at Clais Dhearg as late as August (NLS MS. 994, 64, 66, 114). Carriage problems and bad weather delayed the end of the season; in the summer of 1789 there was a serious shortage of horse-grass at Callart, where the woods were some distance from the shore, and by late October it was evident that some coals would remain stacked in the woods over the winter (NLS MS. 994, 39, 98). 1790 was an exceptionally wet coaling season and the product was generally bad; coals were ready in Morvern in late August but horses were not available and Longmire asked that coaling should be allowed to stop at Callart until spring; work did not finish in the Lochbuie woods until November (NLS MS. 994, 115-16, 120).

There was some danger that the supply of coals made in spring would be exhausted before the first coals of summer arrived at the furnace, but the critical period was generally in April or May, when the coals of the previous summer had almost all been used; concern about the possibility of 'splicing' the supplies in spring began immediately after a bad summer. When the furnace was blown out for repairs in September 1787 Longmire was anxious enough about the coal supply to delay the resumption of blast and offer a higher price than authorised for manufactured coals (NLS MS. 994, 31-2, 36). Coals sufficient for twenty-five weeks were in stock when the new blast
began on December 1 and blast was maintained through spring, although the winter supply was almost exhausted when the first coals of summer arrived in June 1788 (NLS MS. 994, 42, 57). On December 1 1788 the stock of coals was only sufficient for twenty-three weeks and by the middle of April 1789 splicing seemed improbable; Longmire offered additional payment for coals delivered at the end of the month but the furnace had to be blown out in early May (NLS MS. 994, 67, 80-1). In the following season only ten weeks' supply was available at the furnace on January 1 and despite determined efforts to obtain sufficient coals the furnace was again blown out on April 22 1790, the day before new coals finally arrived (NLS MS. 994, 103, 108, 110).

The entire process of cutting and coaling was carried out by teams of men under skilled master coalers, although in some circumstances the less skilled preliminary work was carried out by others. Thus in 1796 the company arranged with a timber merchant who had coalwood to sell that the timber should be cut and stacked by the merchant's men and coaled by a skilled man sent from Lorn (NLS MS. 993, 60). The master coalers were not full-time employees; after the wood agent had allocated him a section of coppice each coaler recruited the few men necessary for his own team and was paid by the dozen of coals produced (NLS MS. 994, 5, 76, 115). As the coalers and their men almost all held land from the company or neighbouring
proprietors there was some difficulty in keeping them on sites far from Lorn; a number of the master coalers sublet the preliminary work and then coaled their quotas as quickly as possible in order to return to their holdings (NLS MS.994, 64, 111).

This made it possible that work would be negligently performed, and Longmire tried to find solutions to these problems; in 1788 he proposed that the wood agent should auction the more attractive jobs near the furnace and allocate the more distant woods to the other master coalers (NLS MS.994, 64). In the following year Longmire decided to set crofts in Muckairn on condition that the occupiers would work at set rates in the woods or on the shore when required by the company; this was not well received by the wood agent and master coalers, who preferred to employ men working voluntarily, even at higher rates (NLS MS.994, 76).

The number of coaling teams employed is not certain but was not evidently large. Coaling jobs as large as 180 dozens were set to individual teams and it was therefore possible that no more than eleven teams might be required to produce 2,000 dozens during a year (NLS MS.994, 5). In some seasons the supply consisted of small purchases scattered over a wide area, however, and the availability of a coaling team was therefore a critical factor in determining whether or not an additional area was purchased (NLS MS.995, 62-3). It may be noted that in south Yorkshire in the first half of the century the furnaces gener-
ally produced 450 tons (457 t) per year and employed four or five teams in each season (Raistrick (1938-9) 59). The wages paid for coaling at Lorn cannot be established; the rates of payment per dozen from which the master coaler paid his labourers were individually negotiated (NLS MS.994, 115). The true value of wages was also affected by the company's practice of importing meal and selling it to the workers in the woods and on remote sites (NLS MS.994, 25, 77, 108, 113).

The method of coaling at Lorn probably followed the general British practice as described by Evelyn in the seventeenth century and still occasionally practised at present. A level site was chosen and cut timber was carefully stacked around a central stake, then covered with turf and fibrous vegetable matter. After the stake was removed and a fire kindled in the vacant space the processes of coaling and 'saying' or cooling took between two and ten days; coaling by this method required a high degree of skill (Nisbet, ed. (1908) V.2, 113-7, Fell (1908) 133-4, Reynolds (1961) 2). The finished charcoal was then put into sacks of specified dimensions which were filled to a certain level; twelve of these sacks comprised a dozen of coals. Charcoal tends to settle in transit; to ensure that this was not used as an excuse for providing short measure the Lorn management had the quantity in each sack checked both on the coaling site or shipping stage and on arrival at the furnace (NLS MS.994, 60). By the
1780s the master coalers appear in general to have been local men and most seem to have been competent, although master coalers paid according to production but employing men at daily rates showed an understandable tendency to coal timber too quickly (NLS MS.994, 64, 83). The company possessed two outstanding coalers, a father and son named Pittery, in the 1780s and 1790s; they were praised as careful and conscientious workers and were the only coalers regularly mentioned by name in communication with Newland (NLS MS.994, 5, 64, MS.995, 61-2).

The carriage of finished coals was generally achieved in two stages; the sacks were brought to shipping stages by packhorse and then shipped to the furnace. In almost all cases the company expected that grazing would be available on a convenient farm during cutting and that a suitable shipping point would be provided (NLS MS.994 34, 73-4, MS.995, 62-3, 75). Where the woods were relatively close to the shore or the furnace, few horses were required and overland transport was generally a small problem. The Lochnell contract of 1752 allowed the grazing of one horse per coaler and the cutting of woods close to the shore of Loch Melfort in 1795 required only four horses (NLS MS.993, 2, MS.995, 38). In the few cases where an overland journey of a few miles was inevitable, however, carriers were required; feeding and supervision of the additional horses was a considerable problem. Thus during the coaling of the woods of Callart on Loch Leven in summer 1789
charcoal had to be carried over distances of four to six miles (6.4-9.7 km); the carriers refused to make more than one journey for a day's wage and coals were produced faster than they could be transported to the shore. The supply of horsegrass also proved inadequate and several horses had died of starvation by the end of the summer; it was necessary to leave about a hundred dozens of coals in the woods at the end of the season (NLS MS.994, 89, 98, 103).

Horsegrass was not expensive; in 1795 the company paid only £4 sterling for 640 nights at the customary rate of 1½d per horse per night, which had been constant for at least forty years (NLS MS.993, 2, MS.995, 52). The supply of horsegrass was however the subject of a number of the few disputes between the company and the owners of woods. At times proprietors tried to charge higher rates for grazing than were customary (NLS MS.994, 120, MS.995, 55). The horses were muzzled during all or part of the working day but they were grazed during the night on farms which were not infrequently unenclosed (NLS MS.994, 46, MS.995, 55, 76); some damage to crops was therefore likely and although the company disclaimed responsibility for damage of this kind a few proprietors and tenants demanded compensation (NLS MS.994, 120). In other cases the area of pasture provided for the workhorses was inconveniently placed, and quite frequently the supply of horsegrass proved insufficient for the number of animals grazed (NLS MS.993, 56, MS.994, 4, 45, MS.995, 55, 84).
The company's own vessels were employed for the carriage of coals to the furnace quay when possible but small sloops chartered from local owners were more generally used for the carriage of charcoal, bark, men and provisions on the open sea (NLS MS.994, 46, 80, 85-6, 109); small boats were used for journeys on the sheltered waters of Loch Etive and Loch Awe and coals were brought to the furnace from the Muckairn woods by packhorse or cart (NLS MS.994, 27, 53, 98, 114, Shairp, ed. (1874) 143). This aspect of coal carriage presented fewer problems, although vessels were delayed and occasionally wrecked during bad weather (NLS MS.994, 5, 47). The greatest difficulty was that movement to and from the more distant sites was inevitably slow; in the case of the Callart woods, more than thirty miles (48 km) from the furnace by the water, this had serious effects both on work at the site and the supply of coals to Lorn, although problems associated with the much shorter overland journey at Callart were more significant (NLS MS.994, 109-10).

As already indicated the company was willing to buy ready-manufactured coals, but only if they were delivered at the furnace; Campbell of Airds found a market for his charcoal in Cumberland when it became evident that Longmire refused to accept it unless delivered at Lorn quay (NLS MS.994, 18, 20, 23, 34). This aspect of company policy cannot be explained by the difficulty of finding vessels or reluctance to divert the company's labour and
equipment from its own purchases. Although casual users of coastal shipping in Argyllshire could not always find a suitable vessel quickly, the Lorn agents were able to offer sloops for use in bringing coals to the quay from Airds and other lands (NLS MS.995, 18, 114, 118-19, MS.995, 30); the company was also willing, when buying charcoal from timber merchants, to undertake every stage of the process following the initial stacking of timber for coaling (NLS MS.995, 60). It seems most probable that insistence on delivery at the quay ensured that short measure and breakages, both of which were more evident after the sea journey, became the responsibility of the supplier; the company required that charcoal bought in this way should be of good quality and was therefore able to refuse deficient coals (NLS MS.995, 65).

The relationship between the costs of coaling and carriage and the value of charcoal to the company is not easily assessed; relevant information is generally fragmented if available at all. The company's method of evaluating coppice is indicated by the estimate of Ardchattan woods in 1788. The wood agent estimated that it would cost 16/0d per dozen to manufacture coals and bring them to the shore; Longmire valued the charcoal at 12/0d and the sums when added are equal to 28/0d, approximately the price the company was then willing to pay for manufactured coals delivered at Lorn. Similarly the cost of preparing bark was set at 28/0d per ton and the value at 70/0d. The difference between the resulting total of 98/0d and the
market price of 100-120/0d then available for bark is probably accounted for by the cost of shipping bark to southern markets (below, 11.6); in 1787 the shipment of bark from Lorn to Port Glasgow cost 14/0d per ton (NLS MS.994, 33, 71). A large quantity of measurable timber was also valued at Ardchattan; the total value of £936-5s, excluding manufacturing and carriage costs, appears to represent the highest price which the company was willing to pay for the woods; all the costs of manufacture and carriage were generally paid by the purchaser (NLS MS.994, 71).

The Ardchattan woods lay within three miles (4.8 km) of the furnace by water; in the same year woods were valued on Loch Craignish, almost forty miles (64 km) from the furnace by sea. The woods contained twenty-five tons of bark which were estimated to cost 30/0d in preparation, and 300 dozens of charcoal for which the cost of manufacture and carriage was 16/0d with an additional 8d per dozen in sundry expenses (NLS MS.994, 52). As costs before shipping were slightly higher the value of the produce in the terms set out above would be lower, at 68/0d per ton and 11/6d per dozen respectively, in relation to the total prices of 98/0d and 28/0d. The highest theoretical value or offering price for the quantities stated would therefore be £257-10s and a separate estimate prepared on the proprietor's behalf valued the woods at 250 guineas (£262-10s), but the company's successful offer was only £200 (NLS MS.994, 52, 56). The bark was shipped on a separate account; the difference of £57-10s between valuation and purchase
price may therefore represent the cost of shipping 300
dozens of coals to Lorn, at a cost of over 3d more per
dozen than shipment from Ardchattan.

These examples suggest that the cost of production
of charcoal on different sites varied relatively little
and that differences in carriage costs were much more
important in affecting the value of woodland to the company.
In the case of woods like those of Kinlochmoidart and Call-
art, where the timber was several miles from the shipping
point and at least as far from the furnace by sea as the
Craignish woods, the combined cost of haulage by land and
water must have caused a significant reduction in the value
or offering price which the company set on the woods. In
such circumstances it would be necessary for the agent to
accept the need to pay an uneconomically high price for
charcoal if the proprietor was not willing to accept a sum
considerably smaller than that offered for woods of compar-
able size and quality closer to the furnace. It is poss-
ible, however, that in some cases the profit arising from
the sale of bark and timber was used to cover the cost of
coaling and carrying timber which in itself would have been
too expensive for the company's use.

11.6 Bark and timber

The importance of bark to the company has already
been indicated indirectly by the organisation of the coali-
ing seasons to suit bark stripping (above, 11.5); the
proportion of oak in an area of woodland was a matter of some significance. Thus during negotiations for the Clanranald woods in Moidart and Arisaig Harriman stated that it would not be worth sending the workpeople so far if the area of timber reserved for the tenants consisted of a certain wood which contained oak fit for cutting (NLS MS.995, 26). Oak bark was available without restriction from the tack lands of Muckairn and all the principal supplementary purchases also included both oak timber and bark. Although the terms of the Breadalbane contracts of 1752 allowed the proprietor to retain the oak bark the company bought it along with the charcoal during the first ten-season cutting and this was also evidently done during the cutting which started in 1800 (NLS MS.993, 43, 62). The Lochnoll contracts similarly allowed the proprietor to dispose of the oak bark on his own account, but Lochnoll generally sold the bark to the company when areas of woodland became due for cutting under the charcoal lease (NLS MS.994, 9, 79-80, MS.995, 86, MS.993, 68).

It is evident that the company was generally able to sell about two hundred tons (203 t) of bark in each season. At least 222 tons (226 t) were shipped out in 1786; information about the 1787 season is limited but in 1788 167 tons (170 t) were shipped to the Clyde alone and additional cargoes were sent to destinations in northwest England.
It was estimated that 193 tons (196 t) would be available during 1789; in 1790 over 100 tons (102 t) had been sent to the Clyde by early October and another 100 tons remained in hand (NLS MS.994, 79-80, 117). Most of the bark went to tanners in the Glasgow district, but cargoes were regularly sent to Milnthorpe and other points in Lancashire, and occasionally to northern Ireland (NLS MS.994, 6, 61-3, MS.995, 4, 25, 29-30, 81). Longmire observed that an increasing amount of finished leather was imported to the district and suggested that the company should set up a tannery locally; Harrison did not follow his advice and in 1790 a member of the Stevenson family opened an independent tannery in Oban (NLS MS.994, 88, 105, 117). This tannery placed regular orders in the next few years and another new works in Campbeltown also took bark from the company (NLS MS.994, 114, MS.995, 8, 47, 67).

Sale to the few regular customers was on a quota system resembling that used in the sale of pig iron; at the beginning of the season the Newland management promised to supply a certain quantity to each customer and any residue at the end of the season was available to them or to casual customers (NLS MS.994, 35, 63, MS.995, 8). Bark was invariably shipped from the shore near the working site rather than the furnace quay, even in the case of the Muckairn woods; this complicated the movement of vessels to some extent but the expense of trans-shipment was avoided. The cost of shipping bark to regular customers was also
reduced by use of the company vessels and sloops which made the journey to the Clyde regularly (NLS MS.994, 27, 60, 63-4, 88, 115). When it was necessary to charter additional ships freight rates were not unduly high; in 1787 and 1788 a ton of bark could be delivered to Port Glasgow for 14/0d or 15/0d, excluding port dues, and the rate was still 15/0d in 1791 (NLS MS.994, 33, 60, MS.995, 2). By 1796 Harriman was prepared to offer 20/0d per ton for delivery to Port Glasgow from Arisaig, but by 1809 the company was able to deliver direct to the Broomielaw in Glasgow, saving 8/0d in river freights and other charges; in 1811 the total cost of shipping a ton of bark to the Broomielaw was about 26/6d (NLS MS.995, 59, 79, 82).

If the distance is considered this does not compare unfavourably with Monteath's estimate of 20/0d as the average cost of overland haulage of bark; even after the opening of the Crinan Canal in 1801 the distance by sea from Lorn to Port Glasgow was about one hundred and ten miles (177 km), and Arisaig was almost one hundred and fifty miles (241 km) from the upper Clyde (Monteath (1824) 261-5, O'Dell & Walton (1962) 205). With a stable base of operations, a regular supply of bark with limited competition, and a fleet of vessels, the company was in a stronger position than the small bark merchants of most other Scottish coppice areas; a certain amount of local competition was inevitable when prices rose in the late eighteenth century, but the company appears to have retained its position as
the principal purchaser of coppice wood in north Argyllshire. Little need be said about the trade in timber; as already indicated, the agents were reluctant to coal wood which was more valuable sold whole; oak, ash, and other species were sold thus throughout the period when available in measurable dimensions (above, 11.5). This trade was not as large and regular as that in bark, however, and there is little evidence that the company ever bought woodland principally for use as timber rather than coalwood.

11.7 Management principles and practice

A limited amount of evidence is available about the form of management employed by the company in the woods under its control, but the agents were certainly aware of the dangers of uncontrolled grazing. In 1786 and 1787 there was a disagreement with Lochnell over the treatment of woods in Glenkinglass, part of the area under the charcoal lease. In December Lochnell and his commissioner, Campbell of Easdale, informed the agent that they wished the wood of Narrachan, which the company had planned to cut in 1787, to remain uncut for four years; this would let the young growth rise and as the tack of the farm expired in four years it would then be possible to have the wood enclosed (NLS MS.994, 9). It would presumably have been necessary otherwise to pay an abatement to the tenant. Longmire hoped that the woods which the company planned to cut in 1787 in place of Narrachan would be enclosed as before and in February the new factor visited Glenkinglass to inspect possible lines for the fences (NLS MS.994, 12).
Later in the month, however, Longmire was informed that although Lochnell was willing to have the woods enclosed the cost of abatement made it possible to enclose only a small area of oak for seven years; this proposal offered limited protection, and as Longmire described it to Harrison at Newland, would only 'let the other rise against the Teeth if it can'. It was claimed that the lands were on long lease; although some abatement was in Lochnell's option it would not be possible to enclose the whole wood even if the company agreed to pay the full rent of the farms (NLS MS.994, 13).

Shortly afterwards Longmire was informed by one of the tenants that they were determined to obtain abatement, but that their farms were on annual lease. Relations with Lochnell were not good at the time, and it is possible that the cost of abatement was not the real point at issue; the new Lochnell factor had made it clear that he regarded the 1752 contracts as disadvantageous to the proprietor and there was also disagreement over the apportionment of the cost of building an inn at Taynuilt on the company tack lands (NLS MS.994, 14-15). Early in March Longmire decided that when the local proprietors met to discuss other business he would propose that the company should have the woods enclosed for seven years and pay the equivalent of the abatement during the period, if Lochnell arranged the building of the inn (NLS MS.994, 15-16). Harrison evidently suggested a different policy, and late in March Long-
mire proposed to the factor that the company should pay £200 for the building of the inn if the woods were enclosed and protected as before; this would benefit Lochnell, his tenants, and the company (NLS MS.994, 17). Lochnell had not accepted the proposals by May, however, and the parties did not reach agreement at a meeting in July; there is no more information about the matter and it is possible that the company was obliged to comply with Lochnell's first suggestion (NLS MS.994, 23,28).

The company's attitude to grazing is also evident from other dealings with Lochnell. Not all the farms of Muckairn were included in the lease of 1752 and in 1787 Lochnell and Easdale made unsuccessful attempts to exchange the farm and woods of Barglass for other farms held in tack by the company (NLS MS.994, 28-9). When the long leases of some Lochnell farms approached expiry in 1789 Lochnell proposed the exchange of Barglass for the farm in Muckairn held from the company by the factor. Longmire rejected this offer and instead offered to take a lease of Barglass and the adjoining lands of Fearnoch Moor for five to seven years; the principal reason for this offer was that the wood on Barglass, which was badly kept and uneven in growth, would be fit for cutting and worth £100 after seven years of protection; if well maintained for a few years after cutting it would be worth twice as much after nineteen or twenty years. Longmire wanted the unwooded land of Fearnoch Moor because the fence between the two farms was poor, and he was willing to pay for this land to ensure that he
could install a tenant who would not let his stock trespass in the Barglass woods (NLS MS.994, 94-5). Lochnell refused this proposal and set the lands to others, and in 1793 Easdale offered the company a cutting of the woods of Barglass and Clachadow, a farm in the south of the parish which was not included in the tack of 1752 (NLS MS.994, 95, MS.995, 16).

Other difficulties arose over enclosure. In 1789 Longmire advised Harrison to give the tenancy of certain farms only to men who would prevent trespass by their own stock and that of other farms; one candidate, who supplied horses to the company, was notably careless about supervising the movement of his animals (NLS MS.994, 98-9). In the 1780s and 1790s extensive sheep farming developed in the neighbouring parishes and additional precautions were necessary; in 1788 there was a dispute over the quality of the fence on the boundary between Muckairn and the lands of Campbell of Sonachan, an enthusiastic sheep farmer (NLS MS.994, 53, OSAS V.6 (1793) 177, 269, V.11 (1794) 122, 128). Sheep fence was erected round Barglass in the same year and in 1796 Harriman found it necessary to warn a resident of Kilmore parish about the trespass of sheep in the lands and woods of Auchnacoshan (NLS MS.994, 61, MS.995, 58). In 1790 stock from Easter Culnadalloch, which was held by the company, or Kilmaronag, which was not, damaged the young growth of part of Clais Bhearg cut in the previous year (NLS MS.994, 105).
It is not clear how much of the company's woodland in Muckairn was enclosed. The tack of 1752 required that the existing enclosures should be maintained in an adequate condition and that the company should share with Lochnell the cost of fencing the boundaries of the tack lands; Lochnell had already enclosed a considerable part of the oak of the parish (NLS MS.993, 2, 31). As already indicated temporary fences were in use in the woods of other parts of Lochnell's lands; there is no evidence in the surviving company records to indicate either the maintenance of dykes or fences, which would be necessary if permanent enclosures were used, or the inspection of coppice to establish whether it could safely be grazed, which would be important if wood was protected only for six or seven years after cutting. The first Ordnance Survey maps of the area, which were produced in the last years of the company's operation, suggest that almost all the wood of Muckairn was in compact enclosed sections (05 1" 45 (1876m).

It should be noted that most of the area held in tack was under wood or was used for the grazing of work horses and the production of hay; much of the remaining arable land was let in small sections or crofts to the furnace staff and others; it was noted that emphasis on wood and hay reduced the area under conventional forms of agriculture and made it necessary to import meal (OSAS V.6 (1793) 176, NSAS (1845) V.7 (Argyll), 520). As a consequence of this it is very probable that the density of grazing
animals was lower than in other districts of north Argyllshire; although the agents occasionally stocked areas of pasture with young cattle most of the grazing stock probably consisted of the small numbers of cattle kept by crofters and furnace employees (NLS MS.994, 42, 57, 98). Under the terms set in 1787 and 1788, when the number of crofts was increased, each tenant was allowed grass for one cow for each 20/0d of rent (NLS MS.994, 39, 63-4); there is no evidence that sheep were kept on the company lands in any numbers and the total number of animals was almost certainly small. It is perhaps significant that the minister of the combined parishes of Ardchattan and Muckairn recorded in 1845 that there were 32,000 sheep and 720 head of cattle in Ardchattan, but provided no comparable numbers for Muckairn (NSAS (1845) V.7 (Argyll), 503-5, 519-20). The company horses were generally confined to a few small areas when not employed in carriage. Horses were summered on a farm in Glen Lonan in the lightly-wooded southern part of the parish; in 1789 Longmire proposed that a strip of wooded land along the River Awe near the furnace and quay should be enclosed as summer grazing for the horses; the Park of Aird, which was also near the quay, was to be reserved for winter grazing (NLS MS. 994, 57, 72-3, 98-9).

Company policy concerning the age at which coppice cutting took place was flexible (above, 11.4); areas of
woodland were frequently not used until three or four years after they became fit for cutting. The terms of the basic contracts indicate a rotation of twenty-four years, but the company was prepared to follow more general Argyllshire practice and cut at nineteen or twenty years if necessary, as Longmire's statement about the wood of Barglass indicates (NLS MS.993, 2-3, 10, MS.994, 94-5).

Certain woods on the Lochneil lands cut in 1787 and 1788, however, were not cut over again until twenty-five years had elapsed (NLS MS.993, 68, MS.994, 9, 36, MS.995, 85). The agents had little interest in the cutting of timber which they regarded as too young; the quality of bark and coalwood improved until about the twenty-fifth year and it was clearly to their advantage to purchase mature coppice. The woods in Ardnamurchan and Sunart offered by Sir James Riddell proved on inspection to be at least three years too young. Longmire sent Riddell the wood agent's estimate of the times at which the sections would be suitable for cutting and declined to purchase them before then, stating that 'no doute your Tenants will stande to its Preservation much more duering the time it is yours, than when sold to Strangers' (NLS MS.994, 83, 86). Although competitors showed some interest in the Riddell woods, it was clearly impracticable for the company to lay out money on the purchase of timber until some return could be expected from the expenditure (NLS MS.994, 105).

The wood agents may have supervised thinning, restock-
ing, and other routine tasks in the woods of Muckairn, although there is no direct evidence of this. Thinning was of limited value in coalwood coppice management, as the production of a limited number of large straight stems was not the main objective; it cannot be certain whether regular replacement of old and exhausted stools was necessary in the Muckairn coppices. The wood agents appear to have been regarded highly outside the company; there were few skilled wood valuators in the county and the Argyll estate managers requested the services of the company men when it was necessary to decide whether or not the coppices of Mull and Morvern were to be opened for grazing (Cregeen, ed. (1964) 177, 183, 185, 190-1).

It is unlikely that the fifth duke and his agents would have relied on the wood agents' opinions about the opening of coppice if there had been any real doubt about the competence and integrity of the company and its employees. Similarly McLain of Lochbuie, who professed ignorance of the value of his woods, invited the agents in 1787 to provide the valuation of woods which he intended to sell to the company; no other valuation was made and it is unlikely that Lochbuie would have been so trusting if the furnace staff were regarded as unscrupulous or reckless exploiters (NLS MS.994, 20). Commitment to a long tack made a policy of conservation advisable; the
terms were very favourable to the purchaser and it may be suggested that the company adhered strictly to them in order to give successive Lochnells no opportunity of having the agreement terminated. None of the internal correspondence of the company preserved in the letterbooks indicates that the company in general or individual employees regarded the enterprise as a short-term exploitative activity.

The management made some effort to make the works acceptable to the local community. When cargo space was available in company vessels kelp, wool, and other commodities were sent to southern markets for proprietors, and goods were purchased for them in Lancashire when required (NLS MS.994, 2, 6, 14, 60, 63, NSAS (1845) V.7 (Argyll), 520). The agents were also careful to be seen to deal fairly with tenants and employees. For some years the company bought wool and set part of it out to be spun for the markets of northern England; this enterprise provided additional employment and a small profit for the company. In 1788 Longmire informed Harrison that the wool which he had bought during the year was poor and unlikely to be profitable, but as the suppliers' rents had recently been increased he was reluctant to refuse it (NLS MS.994, 62, Smith (1805) 303). Exceptionally wet weather in 1788 severely damaged a hay crop which the company had already sold on the ground; Longmire suggested to Harrison that any strict attempt to exact payment from the purchasers would be unjustifiable morally and would not raise the standing of the company in
the eyes of the community (NL3 Ms. 994, 63). It may therefore be said that the company had good intentions, and there is evidence that they were put into practice in the management of coppice. Although the company records give little indication of the form or quality of management, the observations of travellers are informative; the following was written by William Singers in 1829:

'Travellers are delighted in passing through any district in which regular attention is paid to the forests, even when reared for the purpose of charcoal. No one can traverse the lands, held under long lease by the Lorne Furnace Company, from General Campbell of Lochnell, between Oban and Inveraray, without a feeling of this kind; when the former waste state of that large tract of country is also contemplated, and contrasted with the marks of industry which appear, and the beautiful appearance of the regularly preserved and rising trees' (Singers (1829) 139).

The standard of management maintained by the proprietors from whom the company bought wood was unfortunately not uniformly high. As already noted, some proprietors tried to sell coppice at ages which were unacceptable to the company; in some cases the sale of coppice was an expedient to raise money in the short term. Thus Cameron of Callart sold his woods on Loch Leven because he was in need of cash, and the arrangement whereby £1,000 of the £1,600 purchase price of Clanranald's woods was paid immediately agreement was reached also indicates the need for
ready money; Clanranald appears to have been more genuinely an exploiter, making little of the profit of his lands and resources available for the benefit of their inhabitants (NLS MS.994, 32, MS.995, 32, 35, Smout (1969) 349). A limited number of proprietors enclosed their woods. The fifth duke of Argyll embarked on an extensive programme of enclosure in his north Argyll coppices in 1785 (Cregeen, ed. (1964) 121-6); the proprietors of Ardchattan and Barcaldine, who together owned most of the estimated 2,500 acres (1,012 ha) of coppice in Ardchattan parish, both reserved timber for fences when selling wood, and Sir James Riddell enclosed at least part of his woods in Sunart (NLS MS.994, 35, 71, MS.995, 52, NSAS (1845) V.7 (Argyll), 305). Cameron of Lochell and his kinsman Cameron of Fassfern both sold coalwood to the company; in the early nineteenth century they were said to be the only proprietors in Inverness-shire who made serious efforts to enclose their oak woods, although as late as 1791 their woods were said to be in general unenclosed (Newte (1791) 122, Robertson (1808) 209-10).

In many cases coppice of all species remained unenclosed and was available as pasture or even as arable land; when the company bought woods at Oib in Knapdale in 1798 the tenants were found to be ploughing in and around the woods, destroying former coaling platforms and restricting the area available for horsegrass (NLS MS.993, 56). The development of extensive sheep-farming provided an alternative use of wooded land; in 1827 Monteath noted that in
Argyllshire as a whole and especially on the coast between Inveraray and Campbeltown, extensive areas of former coppice of oak and other species had been laid open to sheep grazing (Monteath (1827) 53-5). By that time the closure of Argyle Furnace had removed the main market for coppice timber in the southern part of the county.

A number of proprietors who sold deciduous woodland showed ignorance of the methods of management and coppice cutting. McLain of Lochbuie openly stated that he knew nothing of the value of his woods, but was nevertheless surprised when told that they were poorly kept (NLS MS.994, 20, 34). Macdonald of Traigh raised objections to the methods used by the company cutters, apparently through unfamiliarity with the customary practices and privileges of coalwood cutting (NLS MS.995, 29). Cameron of Callart, from whom the company bought woods shortly before he was forced to sell his lands on Loch Leven, was described to the company agent as a very simple trifling person (NLS MS.994, 20, 52 MS.995, 75). The agents could do little to alter this situation except in offering advice and warnings; writing to Sir James Riddell in the early 1780s Longmire stated that the protection of coppice in Argyllshire was so inadequate that many areas which the company had formerly cut had declined since into uselessness, and that without improvement the whole coppice area of west Argyllshire would be insufficient to maintain a furnace (Fell (1908) 409). The furnace remained in operation for almost a century after this statement, which may therefore be taken as a deliberate
exaggeration, but the company had little power to improve the general standard of coppice management in the county.

11.8 Effects on the quantity and quality of woodland

Some contemporary observers expected that the works and the woods on which it depended would have a short existence. Pennant anticipated in 1769 that the woods of the district would soon be destroyed; Heron, who appears to have misunderstood the nature of extensive oak coppice, recorded that a considerable part of the extensive woods of Bonawe had been cut and coaled and that the rest was being treated in the same way (Pennant (1771) 188, Heron (1793) 296). Saint Fond visited the works in 1784 and talked with the agent; although impressed by the skill and economy with which it was operated he believed that the works would soon be forced to close, as the woods were too small in area and too slow in growth to be cut regularly (Geikie, ed. (1907) V.2, 149-50). Despite these predictions, the furnace remained in operation for more than ninety years after Saint Fond's visit. When the lease expired in 1863 a local man took a tack of the Muckairn lands for twenty-one years, subletting the furnace site and the charcoal to the company; the works was finally closed in 1876 (Fell (1908) 413, Macgregor et al. (1920) 4).

Production seems to have been small and intermittent in the later part of the period of operation; stated production in 1839 was only 400 tons (406 t) and during the
last two decades of operation the furnace was out of blast in the years 1859-62, 1864-7, and 1872 (Mushet (1840) 421, Macgregor et al. (1920) 4). Although this might be taken as evidence supporting Cadell's conclusion that the works closed when prices fell and the supply of wood was exhausted, it should be remembered that Lorn Furnace was one of the component parts of a company which was the only major domestic supplier to a diminishing market; it is therefore possible that production was gradually reduced as the market declined and that the Newland management did not keep all the works in blast at times when the demand for charcoal iron was small. A reduction in the supply of fuel marked enough to lead to the closure of the furnace would probably have been evident for some time previously, and it would be likely in such a case that the termination of the original contracts in 1863 would be taken as an appropriate time for closure.

Cartographic evidence relating to Argyllshire is not generally satisfactory but indicates that exhaustion of coppice wood was not the principal reason for closure of the furnace. The main sources of map evidence in this case are the Military Survey, produced shortly before the furnace was built, and the first Ordnance Survey maps of the district, which were based on surveys carried out in 1870 shortly before the furnace closed. The county map produced by George and Alexander Langlands in 1801 is unfortunately too small in scale and inaccurate to be of any value in
Figure 11.3. Woodland in Muckairn, 1750.
Figure 11.4. Woodland in Muckairn, 1876.
this context (M.S. (1747-55m) 13/2, Langlands & Langlands (1801m), O.S. 1" 45 (1876m)). Initial comparison of the distribution of woodland indicated by the maps of 1750 and 1870 is provided by Figures 11.3 and 11.4, which suggest that the area of wood in the parish of Muckairn and on the other lands held in tack increased considerably over the period (Fig. 11.3, Fig.11.4).

This impression may be misleading. The Military Survey sheet in question is not among the most accurate; the surveyors omitted the woods around Clais Dhearg and may have underestimated the extent of other woods (M.S. (1747-55m) 13/2). The same team probably produced the survey of Glenkinglass, in which woodland was not marked on a number of sites where it was later cut by the company and still survives (M.S. (1747-55m) 14/4). As already indicated the transfer of patterns from early maps to base maps with a modern format is at times difficult, and the representation of the woodland identified by the military surveyors is an approximation (above, 1.5). Measurement of the pattern of woodland represented in Figure 11.3 therefore yields only a rough estimate of the area of woodland, which then appears to have covered about 1,850 acres (749 ha), equivalent to nine per cent of the area of Muckairn (Fig.11.3). Measurement of the area marked in 1870, however, indicates that woodland of compact form covered more than 3,950 acres (1,600 ha); with the addition of the small area of open woodland the total was slightly more than 4,200 acres.
(1,701 ha), or 20.6 per cent of the area of Muckairn (Fig. 11.4).

There was therefore apparently a remarkable increase in the extent of woodland during the company's period of operations; if the omission by the military surveyors of the woods in the west of the parish, which existed thirty years later, is excepted, the distributions of woodland at the two dates are very similar. The difference between the two is most likely to derive from a consistent error on the part of the earlier surveying team or from augmentation by planting in the vicinity of existing woods; there is no evidence of planting in Muckairn by the proprietor or the company and Figure 11.3 may therefore underestimate the area of woodland in 1750. Even if only fifty per cent of the woodland existing at the time was represented, however, the total would be less than that of 1870; cartographic evidence therefore provides no support for the belief that the company reduced the extent of woodland in the district. It is possible that not all of the woodland of Muckairn was managed as coppice, especially when production at Lorn Furnace decreased; in 1845 the minister of the parish estimated that Muckairn contained only 1,900 imperial acres (770 ha) of coppiced wood (NSAS (1845) V.7 (Argyll), 520).

It should be noted that McVean has identified the undulating upland woods of Muckairn parish north of Glen Lonan as the most extensive area of oak scrub in the west
and perhaps in Scotland as a whole. The woods at present consist mainly of oak with a hazel stratum, although there are some areas of birch scrub. The quality of the wood is not uniformly high; much of it is poor scrub and parts have been planted up with conifers, but the wood of Clais Dhearg includes several hundred acres of relatively small oaks in close canopy derived from recent seeding or coppice growth (McVean (1964a) 157). After the removal of protection oak has declined rapidly in other parts of the Highlands; the continued interest of the furnace company almost until 1880, when much of the oak coppice of Scotland had been abandoned, may have allowed the Muckairn woods to survive in relatively good condition.

Less information is available about the other woods cut by the company. The range of purchases in the period 1786-1813 is indicated by Figure 11.2; the availability of water transport allowed use of the woodland contained in a remarkably large area. The Lorn Furnace managers therefore had greater freedom of operation than the managers of inland ironworks and were not compelled to make the maximum use of a limited area of woodland in the immediate vicinity of the furnace. Little information survives in most cases about the composition, quality, extent and exact location of the woodland purchased by the company; it is known that some areas were cut over at least twice but it cannot be certain in general how many times a given area of timber was cut over for charcoal production. There is little
evidence to suggest that wood has disappeared completely from sites on which cutting for charcoal is known to have taken place, although in some cases the area may have been reduced and quality diminished.

The main determinant of survival was the form of treatment after cutting rather than cutting itself; management of coppice was the responsibility of the proprietor, and although the furnace agents were willing to lay out money for Campbell of Lochnell to enclose woods in Glenkinglass it was clearly not feasible for the company to subsidise the cost of adequate coppice management throughout the county without concrete assurance that the outlay would be recoverable. The company depended on the cooperation of the owners of wood, but not all of them managed coppice at as high a standard as the company itself appears to have maintained. Even if the ironworks management could offer no positive incentive for the protection and improvement of woodland it is possible that the presence of the works raised the standard of management more than might have been expected if tanbark coppice alone had provided a commercial market for timber as well as bark; the management of the company's own lands provided an example and the furnace staff included skilled men able to offer advice and guidance to proprietors.

It may be said in conclusion that there is no evidence to indicate that the presence of the Lorn Furnace Company
was directly harmful to woodland in Argyllshire. It is in fact probable that the company improved the standard of management to some extent and helped preserve woodland in the county. As already indicated some observers considered that the presence of the two ironworks in the county had raised the value of woods and therefore given proprietors a reason to manage and protect their timber as coppice (above, 11.4); Walker thought that for this reason the woods of Argyllshire were the best-managed in the Highlands (Walker (1812) V.2, 208). It is evident, however, that some proprietors took advantage of the increase of prices without paying attention to the protection of their woods.

Argyle Furnace also appears to have been favourably regarded; it was praised for providing employment and raising the value of wood, and the management was on friendly terms with the local community (OSAS V.5 (1793) 298n). The managements of both furnaces had leases on favourable terms which were probably of crucial importance in allowing production to continue so far from markets and sources of ore; the furnace staff therefore had an interest in conserving resources over the period of these long leases, and the activity of the companies can be seen as destructive only in providing the less responsible proprietors with a reason for cutting and selling wood as coppice without attending to the protection of young growth.

If commercial markets had been absent little attention would have been paid to the preservation of such wood.
An alternative commercial market existed in the form of demand for tanbark; in the absence of the ironworks this would almost certainly have been the main market for Argyllshire coppice produce and there is no reason to believe that the standard of management would have been any higher. The two works together were probably the largest operating in the Highlands at any time, and their combined working lives of about 180 years comprise the major part of the total known working life of commercial charcoal smelting in Scotland (above, 10.7). It may therefore be suggested that if these works were not themselves responsible directly for the destruction of large areas of woodland commercial iron-smelting as a whole may be considered to have played a very small part in the destruction of Highland woodland.

11.9 Summary

Lorn Furnace was built at Bonawe in 1753 by a Furness company to produce pig iron utilising Highland charcoal and Lancashire ore. Estimates of the area of woodland required for continued production suggest that operation could continue indefinitely with the use of a very limited area of woodland.

A supply of charcoal was assured by long-term contracts. Supplementary supplies were purchased and coastal shipping allowed the use of coppice fifty miles (80 km) linear distance from the furnace. The two companies operating in Argyllshire cop-
yllshire maintained an agreement about allocation of coal-wood and there was little competition from other users.

Coalwood coppice was cut in blocks and timber of most species and dimensions was suitable. Woodland containing oak was cut in summer to allow stripping of oak bark and other woods were cut in a short winter season. There was some difficulty in maintaining a continuous supply of charcoal through the year. Timber was coaled by contract labour. Most woods were close to coastal shipping points; carriage costs were the most variable part of the cost of coaling and in some cases the profit from the sale of bark and timber may have been used to cover high shipping costs.

The coppice on the company's own lands appears to have been carefully enclosed and information available about management does not suggest neglect or exploitation. The proprietors of some woods used by the company maintained reasonable standards of management but many paid little attention to conservation of coppice.

The furnace closed about 1876 after a period of reduced production. Cartographic evidence suggests that the area of wood on the company lands was then no smaller than in 1750 and perhaps greater; part of this area is at present among the best surviving semi-natural oakwoods in Scotland. Survival of other woods in the county depended on the varying management standards of their owners. Lorn Furnace itself was not directly responsible for the destruction of woodland, and it is probable that commercial iron smelting as a whole...
was more significant as a factor encouraging the conservation of woodland than as an agent directly responsible for the decline of Highland woods.
12.1 Conclusions

The primary aim of this thesis has been to examine the use of the semi-natural woodland of Perthshire and Argyllshire in the period 1650-1850, with the particular aim of determining the significance of commercial use of woodland in relation to the overall decline of these woods and decline within that period.

It is evident from examination of non-commercial uses of woodland produce and the use of woodland as part of the area available for grazing and other purposes that such uses took a wide variety of forms and had considerable significance in affecting the area, quality, and distribution of woodland. It is also evident, however, that the diversity of the factors operating and the fragmentary nature of information relating to them permits only tentative conclusions about the importance of individual factors and the group of factors as a whole. In the case of commercial use, however, the range of factors which must be considered is smaller; the timber of Scots pine was used commercially for a limited number of purposes and deciduous woodland was
largely subject to a form of coppicing which was basically uniform throughout the two counties.

In Perthshire and Argyllshire careful management of woodland largely followed the development of profitable and consistent demands for woodland produce; contemporary observers noted that the founding of the two major iron-works in Argyllshire had improved the standard of management in the county and the development of markets for tanbark had a similar effect in both counties, although the main market available for the produce of the pinewood of Hannoch appears to have been that of the rural community within a restricted distance from the sawmill. Commercial demands eventually declined, however, and the diminution of their importance was accompanied by the abandonment of management; the importance of grazing had at all times restricted the development of coppice management, and the high rents available from the lease of land for sheep-farming encouraged the abandonment of the less valuable areas of coppice in the late eighteenth and early nineteenth centuries.

Although attention was paid to the management of woodland in ways which allowed the production of a sustained yield and the replacement of losses, commercial use remained in some cases exploitive. Thus exploitive felling affected some of the pinewoods of Argyllshire and Perthshire, although the wood of Hannoch was systematically managed at least during the period of governmental administration in the
second half of the eighteenth century. Management was widely applied to deciduous woodland cut as coppice but it generally took a selective form. On most estates a limited area of woodland with oak dominance was selected for management, and although woodland without oak was not infrequently cut as coppice it was seldom protected against grazing and non-commercial exploitation. The standard of management varied greatly; in some cases only the most rudimentary form of protection was applied and on some estates management was maintained only for a short period.

Individual cases of managed commercial use have been examined. In the case of the wood of Rannoch management took the form of regulation of the system of cutting and replacement of losses, by encouragement and assistance to natural regeneration and perhaps to some extent by planting. Management of the coppiced woods consisted basically of regular cutting of coppice growth and enclosure as protection against grazing; old and exhausted stools were replaced by planting during the later phase of management in the Mentheith woods, but there is no evidence that this was done in Kincardine Wood or in the woods of Muckairn parish leased by the Lorn Furnace Company. Primitive as were the forms of management employed, they appear to have been sufficient to arrest and perhaps reverse the process of decline to which woodland in the two counties has been subject during the historic period.

Thus there is no evidence of significant decline in the quantity and quality of the pinewood of Rannoch during
the period of governmental administration in the second half of the eighteenth century, and the last phase of free regeneration in the wood may be associated with the enclosure carried out during that period. In the case of the woods of Menteith during the period as a whole there is firm evidence of decline only in the case of woodland deliberately excluded from formal management; the wood of Kincardine may have been reduced in extent to a limited degree by clearance for agricultural purposes. The deciduous woodland of Muckairn managed by the Lorn Furnace Company for more than a century after 1750 did not decline in extent during this period and may in fact have increased in area; one section remains among the best-preserved areas of semi-natural woodland in Scotland.

Regeneration became uncommon in Hanoch before the middle of the nineteenth century; this cannot be attributed to felling, which had been neither regular nor extensive since 1800, and the end of free regeneration appears to have resulted from exposure of the wood to extensive sheep grazing and muirburn, perhaps in association with increased oceanicity in climatic terms. Formal management of the coppices of Menteith and Muckairn continued after 1850; in both cases management ceased in the later part of the nineteenth century, however, and the woods have declined in quality and area since then.
These examples suggest that contrary to the common beliefs examined earlier the decline of woodland in this period was associated not with the initiation of commercial use but with its absence or termination. The history of the woods leased by the Lorn Furnace Company suggests that the role of the iron industry in particular has been grossly misinterpreted. It would nevertheless be inadvisable to assume that commercial use of woodland was invariably beneficial and had no responsibility for the decline of woodland. It is possible that the forms of management employed permitted the decline of both pinewood and deciduous coppice.

It has already been observed that some measures taken to improve regeneration in the pinewood of Rannoch may in fact have contributed to the later decline of regeneration (above, 6.7). It has also been noted that the abandonment of coppice management was associated with the disappearance of much of the oak-dominated woodland on which tanbark coppice management was based (above, 4.8). There is no reason to believe that the decline of oakwood was responsible for the termination of management, but it is evident that in many cases oak coppice was quickly reduced in quality when protection against grazing ceased. As oak grows slowly and regenerates poorly in the Highlands grazing is likely to have converted coppice rapidly into scrub or non-regenerative woodland (above, 7.2); the tendency in coppice management towards the extirpation of barren timber and the creation of
pure oak coppice may in some cases have reduced the possibility that such sites could be colonised by birch and other deciduous trees rather than by non-tree species.

The forms of management which at the time appeared most enlightened may therefore have contributed to the vulnerability of woodland to non-commercial pressures when protection ceased, and there is abundant evidence that management did not invariably reach the highest contemporary standard. It has already been noted that much coppice was exploited or managed only briefly and in a rudimentary way (above, 7.7). It has also been suggested that the smaller pinewoods of the two counties may have been protected from serious exploitative damage only by the meagreness of their resources and their inaccessibility (above, 5.7); the pine-wood of Hannoch itself may have been able to survive largely because the rural districts to which it was most accessible did not generally require more timber than the wood was able to replace.

The area of pinewood in Perthshire and Argyllshire had been greatly reduced by the action of environmental factors and the pressure of non-commercial uses before commercial exploitation had any significance, however, and in the case of coppice even a rudimentary form of protection was evidently sufficient to maintain productivity. It was noted earlier that the responsibility of coppice management for the decline of woodland lay primarily in the creation of conditions in which vulnerable growth was exposed to non-
commercial pressure (above, 7.7). The examples examined indicate that commercial use of both coppice and pinewood was only to a small extent destructive in itself, and that it contributed to the decline of woodland primarily in facilitating destruction by grazing and casual exploitation. At best commercial use provided a temporary respite in the process of decline, and at worst it was accessory to the continued action of non-commercial factors. It appears very likely that in the absence of commercial demands such factors would have continued the gradual destruction of the woodland of the two counties.

It may therefore be said in conclusion that as initially appeared probable commercial use of woodland had negligible significance in the overall decline of woodland in Argyllshire and Perthshire; more significantly in this context, it had only a minor role in the destruction of woodland between 1650 and 1850. The principal role in the continued decline of woodland during this period must be assigned to the continued action of environmental factors and especially the anthropogenic factors associated with pastoralism as practised in the Highlands. The degradation and destruction of woodland brought about by these factors was in some cases accelerated by commercial exploitation and in other cases halted or retarded by management; although commercial factors in some cases modified the way in which non-commercial pressures acted on woodland, there is almost no evidence of the destruction of woodland by commercial use alone.
This conclusion indicates certain directions in which future study may be directed. If the principal role in the decline of woodland in Perthshire and Argyllshire is assigned to the environmental and anthropogenic factors outlined above, it is clearly of value that these should be examined carefully. For reasons which have already been examined, however, it is improbable that the relative importance of the component factors of this group can be established (above, 1.4). Although additional documentary evidence of the form of material culture and agricultural organisation may become available, elucidation of this problem depends on the application of the techniques of field archaeology to a wider range of sites of the historic period in the Highlands than has until now been examined, and the refinement of palaeobotanical and palaeoclimatological techniques to permit examination of the historic past in these terms.

There is also a need for continued documentary study of the role of commercial factors in relation to woodland, and this may prove more immediately rewarding. Study of individual cases is necessarily restricted by the availability of documentary evidence and the examples which are best documented are not invariably the most representative in every respect. Examination of further examples may therefore be illuminating, and additional examination of documentary evidence relating to the commercial use of woodland may provide solutions to some aspects of the use of
woodland in Perthshire and Argyllshire which at present remain obscure. Thus the commercial history of the Argyllshire pinewoods and especially those of Ardgour requires elucidation, and it would also be of some value to determine the degree to which the character of coppice management was regionally differentiated, a problem which has already been examined in broad terms (above, 8.8). It was earlier suggested that the counties of Argyllshire and Perthshire might be considered as having had a distinct regional identity in terms of woodland history, and the importance of these counties in the Scottish trade tends to confirm this (above, 1.5). It is clearly of value to employ similar techniques in an attempt to determine the extent to which other parts of the Highland area had regional identities in similar terms.
LIST OF REFERENCES

PRINTED BOOKS AND PAPERS

In the following list references are arranged in alphabetical order according to the names of their authors. In some cases a name is inserted in brackets to indicate that the author's identity is known with some certainty but is not confirmed in print in the book itself. The publishers of books and papers are identified in this list only in the case of government publications and series issued by historical and record societies. The long descriptive titles characteristic of the earlier books have generally been curtailed but retain their original spelling, word order, and punctuation. The titles of periodicals are abbreviated throughout in accordance with the following guide:


The following periodical titles do not appear in the World List, but have here been abbreviated in accordance with the conventions of the list.

Archaeological Newsletter
Bulletin of the Institute of Historical Research
Economic History Review
Proceedings of the Society of Antiquaries of Scotland
Scottish Historical Review
Scottish Studies
Transactions of the Gaelic Society of Inverness
Transactions of the Historical Society of Lancashire and Cheshire
Transactions of the Royal Scottish Society of Antiquaries

Econ.hist.Rev.
Scott.hist.Rev.
Scott.Stud.
Trans.Gaelic.Soc.Inverness
Trans.R.Scott.Soc.Antiq.
ANON (1747) A journey through part of England and Scotland along with the army ... By a volunteer, London.

ANON (1819) Sketch of a tour in the Highlands of Scotland; through Perthshire, Argyleshire, and Inverness-shire, in September and October 1818, London.

ANON, ed. (1823) A large description of Galloway by Andrew Symson, Edinburgh.


ARROWSMITH, A. (1809) Memoir relative to the construction of the map of Scotland published by Aaron Arrowsmith in the year 1807. London.


BLAIKIE, J. (1829) Observations on the uses to which alder, birch, hazel, and other indigenous trees, generally accounted brushwood, may be applied. Trans. R. Highld. agric. Soc. Scotl. 7, 360-74.


BOSWELL, J. (1785) The journal of a tour to the Hebrides, with Samuel Johnson, LL.D. London.


BURTON, J.H. et al., ed. (1877 ff) Register of the privy council of Scotland. HMSO, Edinburgh.


CA

CAMPBELL A. (1802) A journey from Edinburgh through parts of North Britain. 2 vols, London.

CAMPBELL, D. (1886) The lairds of Glen Lyon; historical sketches relating to the districts of Appin, Glen Lyon, and Breadalbane. Perth.

CAMPBELL, J. (1752) A full and particular description of the highlands of Scotland. London.


CHAMBERLAYNE, J. (1708) Magnae Britanniae Notitia; or the present state of Great Britain, with divers remarks upon the antient state thereof. London.


COCHRAN-PATRICK, R.W., ed. (1878) Early records relating to mining in Scotland. Edinburgh.


DEFOE, D. (1724-7) A tour thro' the whole island of Great Britain, divided into circuits. 3 vols, London.


FORSYTH, W. (1900) In the shadow of Cairngorm. Inverness.


GARNETT, T. (1800) Observations on a tour through the Highlands and part of the western Isles of Scotland, particularly Staffa and Icolmkill. 2 vols, London.


GEIKIE, A., ed. (1907) A journey through England and Scotland to the Hebrides in 1784, by B. Faujas de Saint-Fond. 2 vols, Glasgow.

GEIKIE, J. (1866) On the buried forests and peat mosses of Scotland, and the changes of climate which they indicate. Trans. R. Soc. Edinb. 24, 363-84.


GILLIES, J. (1784) One day's journey to the Highlands of Scotland. March 12, 1784. Perth.


HALL, J. (1807) Travels in Scotland by an unusual route; with a trip to the Orkneys and Hebrides. 2 vols, London.


HEADRICK, J. (1813) General view of the agriculture of the county of Angus or Forfarshire. Edinburgh.


HERON, R. (1793) Observations made in a journey through the western counties of Scotland; in the autumn of MDCCXCII. 2 vols, Perth.

HERON, R. (1806) Scotland described; or, a topographic description of all the counties of Scotland with its northern and western isles. 3rd edn, Edinburgh.


INNES, C., ed. (1855) The Black Book of Taymouth, with other papers from the Breadalbane Charter Room. Bannatyne Club, Edinburgh.


JAMESON, R. (1813) Mineralogical travels through the Hebrides, Orkney, and Shetland Islands, and mainland of Scotland. 2 vols, Edinburgh.


KNOX, J. (1787) A tour through the Highlands of Scotland and the Hebride Islands, in MDCCCLXXVI. London.


KYD, J.G., ed. (1952) Scottish population statistics, including Webster's analysis of population 1755. SHS 3rd Ser. 44, Edinburgh.


LETITIE, I. (1794) Letters on a tour through various parts of Scotland in the year 1792. London.


MACGREGOR, M., et al. (1920) The iron ores of Scotland (Special reports on the mineral resources of Great Britain, 11). HMSO, Edinburgh.


MACKAY, W., ed. (1905) Chronicles of the Frasers; the Wardlaw manuscript. SHS 1st Ser. 47, Edinburgh.


MACKENZIE, G., earl of Cromarty (1710-12) An account of the mosses in Scotland. Phil. Trans. R. Soc. 27, 296-301.


(MACKINTOSH, W.) (1729) An essay on ways and means of inclosing, fallowing, planting &c. Scotland; and that in sixteen years at farthest. Edinburgh.


MARSHALL, W. (1794) *A general view of the agriculture of the central Highlands of Scotland.* London.


MARWICK, J.D., ed. (1866-80) *Extracts from the records of the convention of the royal burghs of Scotland.* 4 vols, Edinburgh.


MONTÈATH, R. (1827) Miscellaneous reports on woods and plantations. Dundee.

MURRAY, A. (1740) The true interest of Great Britain, Ireland, and our plantations. London.


NISBET, J. (1900) Our forests and woodlands. London.

NISBET, J., ed. (1908) Sylva; or a discourse of forest trees, by John Evelyn. 2 vols, London.


OSWALD, M. (1811) A sketch of the most remarkable scenery, near Callander of Monteth. 5th edn, Stirling.


PENNANT, T. (1774) A tour in Scotland and voyage to the Hebrides MDCCCLXXII. Warrington.


RAY, J. (1752) A compleat history of the rebellion. 2nd edn, Bristol.


RENNIE, R. (1814) Of those obstacles to improvement which are local, and chiefly limited to the Highlands and islands of Scotland. In: SINCLAIR, J., ed. (1814) vol.5, 393-413.


ROBERTSON, J. (1794) General view of the agriculture in the southern districts of the county of Perth. London.


ROBERTSON, J. (1808) General view of the agriculture in the county of Inverness. London.
ROBSON, J. (1794) General view of the agriculture in the
county of Argyll and the western parts of Inverness-shire.
London.

ROGERS, C., ed. (1879-80) Rental book of the cistercian
abbey of Cupar-Angus with the breviary of the register.
2 vols, Grampian Club, London.

ROSS, A. (1885-6) Old Highland industries. Trans. Gaelic
Soc. Inverness 12, 387-415.

RYDER, M.L. (1968) Sheep and the clearances in the Scottish
Highlands; a biologist's view. Agric. hist. Rev. 16,
155-8.

SACHEVERELL, W. (1702) An account of the Isle of Man ...
with a voyage to I-Columb-kill, in the year 1688.
London.

agric. Soc. Scotl. 4, 335-40.

SCHUBERT, H.R. (1957) History of the British iron and steel
industry, from c.450 B.C. to A.D. 1775, London.

SCHWAPPACH, A. (1898) Report on a visit to the forests of
Scotland in August 1896. Trans. R. Scott. arboric. Soc.
15, 11-24.

SCOTT, H., ed. (1915-28) Fasti Ecclesiae Scoticanae, 7 vols,
ew edn, Edinburgh.

SCOTT, W.L. (1933-4) Excavation of Rudh' an Dunain Cave,

SCRIVENOR, H. (1854) History of the iron trade (from the
earliest records to the present period). London.

SHAIRP, J., ed. (1874) Recollections of a tour made in Scot-

SIMMONS, I.G. (1969) Evidence for vegetation changes asso-
ciated with mesolithic man in Britain. In: The
domestication and exploitation of plants and animals

SINCLAIR, J., ed.(1791-9) A statistical account of Scotland.
21 vols, Edinburgh.

SINGERS, W. (1807) On the introduction of sheep-farming
2, 536-606.

SINGERS, W. (1829) Essay on converting to economical uses
trees usually treated as brushwood. Trans. R. Highld.
agric. Soc. Scotl. 7, 137-47.


SOMERS, R. (1848) Letters from the Highlands; or, the famine of 1847. London.


THOMSON, W., ed. (1864) Old and remarkable trees of Scotland. Edinburgh.

THORNTON, T. (1804) A sporting tour through the northern parts of England and great part of the Highlands of Scotland. London.


ADDENDUM:

SINCLAIR, J., ed. (1814) General report of the agricultural state and political circumstance of Scotland. 5 vols, Edinburgh.

MANUSCRIPT SOURCES

Limitations of space prevent the description here of each individual document or small group of documents, and catalogues or inventories describing most of the documents cited are contained in the appropriate repositories.

Only basic information about the provenance and nature of
manuscript collections is therefore provided in this list. Manuscripts held by individual archives or libraries are grouped together in series, arranged in alphabetical and then numerical order.

Detailed lists of documents are provided here only in a few cases, to facilitate the identification and location of material which has not yet been fully inventoried or handlisted. These lists are necessarily based on interim classifications designed solely to meet the requirements of this thesis; such classifications are distinguished in text references by the use of square brackets, and it should be noted that the numbers within these brackets are not carried by the documents themselves and will no longer be relevant when comprehensive cataloguing of these collections takes place.

**SCOTTISH RECORD OFFICE (SRO)**

**Exchequer papers:**

E.700 Minute books of the barons of exchequer relating to the forfeited and annexed estates in Scotland, 1747-79.

E.721 Minute books of the commission for the annexed estates, 1755-84.

E.726 Letterbooks of the commission for the annexed estates, 1755-84.

E.777 Papers relating to the annexed estate of Perth, 1747-84.

E.783/1-39 Papers relating to the annexed estate of Struan under the management of the barons of exchequer, 1749-55.

E.783/40-111 Papers relating to the annexed estate of Struan under the management of the commission for the annexed estates, 1755-84.
Papers relating to various forfeited and annexed estates during the period 1747-84.

The accounts and vouchers of the estate of Struan are catalogued E.783/37-9 and E.783/102-6; when reference is made to specific annual accounts the dates in question are placed in round brackets after the appropriate catalogue numbers.

Registers of valuations in Scotland, late eighteenth and early nineteenth centuries.

Gifts and deposits:

GD.1/390 Campbell of Glendaruel papers.

GD.14 Campbell of Stonefield papers.


GD.112 Breadalbane muniments.

GD.112/6/11: Papers relating to the 'Irish Company' and other users of woodland:

[a] Contract between the Breadalbane commissioners on one hand and Arthur Galbraith and Roger Murphey on the other. At Achmore (and Bonawe) September 14 (and November 20) 1723.

[b] Letter, earl of Breadalbane to an estate officer; Stronmilchan, August 3 1725.

[c] Letter, Colin Campbell (of Carwhin) to a Breadalbane estate officer; Stronmilchan, January 27 1730.

[d] Letter, Duncan Campbell of Lochtall and Alexander McMillan to a Breadalbane estate officer; Edinburgh, August 12 1738.

GD.220 Montrose muniments.


GD.220/6(46) Accounts of individual estates, 1701-10.

GD.220/6(47) Accounts of individual estates, 1711-27.

GD.220/6(48) Tenants' ledger for the estates of Menteith and Kincardine, 1739-70.
GD.220/6(49) Accounts of individual estates, 1741-53.
GD.220/6(50) Accounts of individual estates, 1754-71.
GD.220/6(56) Combined estate accounts, 1814-33.
GD.220/6(68) Register of rentals of Menteith, 1694-1743.
GD.220/6(70) Register of rentals, various lands, 1751-1809, with a valuation of woods c.1754.

Some volumes carry their original series of page or folio numbers but others do not have satisfactory pagination, and where reference is made to specific years these are identified in round brackets after the catalogue number. In the cases of GD.220/6(49) and GD.220/6(50) the accounts of individual estates are arranged in an irregular order without adequate pagination. They are therefore here identified by letters (K - Kincardine, M - Menteith, B - Buchanan), which are prefixed to specific dates if these are cited. Thus, for example, GD.220/6(49) (M), or GD.220/6(50) (M1760-2).

The following is an interim selective list of material contained in a box labelled 'wood contracts'. The titles are those carried by the documents themselves; other information is presented in round brackets.

Kincardine documents (Wk.).


[Wk.2] Tak Montrose & Inchbrackie to James Malcolme ffor- ester of th' woods 1656.

[Wk.3] Contract betuixt the Marqueis of Montrose and Robert Stewart 1680.
[Wk.4] Tack and assedatne betwixt the Marques of Montrose and Mr George Drummond 1682.


[Wk.6] Articles and conditions of the roup & sale of the wood of Kincardine at Ochterarder May 1729. (enclosed in Wk.6a).

[Wk.6a] Wood of Kincardine 1731. (letter from tacksman renouncing tack).


[Wk.8] Copy obligation the Duke of Montroses Commrs to Thomas Fenton 1732.

[Wk.9] Copy commission to Geo. Graham to be forester of the wood of Kincardin 1732.


[Wk.12] Contract of the wood of Kincardine betwixt his Grace the Duke of Montrose commissioners and Andrew Carrick 1736.


[Wk.14] Contract of the Broad Wood of Kincardine for 15 years commencing with Cr. 1744 and of parknewke pendicle for said terms 1743.

[Wk.15] (report on the condition of dykes in Kincardine, 1749, enclosed in Wk.10).

[Wk.16] Resolved about the wood of Kincardine as follows, 1749 (enclosed in Wk.10).


[Wk.18] Note about John Gilchrists park dyke on the side of the waters of Ruthven and Lochy 1761.

Menteith documents (Wm.).

[Wm.1] This is for master and buyer of woods (c.1695).
[Wm.2] The prisers of the wood of portnellan thir declaratione 26th Aprile 1700.

[Wm.3] Declaratione be Grahame & Williamsone annent the woods of Blarinrosse, 1703.

[Wm.4] Memorandum anent the woods of Monteath 1703.

[Wm.5] (valuation of the woods of the first division, April 1703).

[Wm.6] (valuation of the woods of Buchanan and Menteith, February 1704).

[Wm.6a] Apprysement of the woods of Monteath and Buchanan 1704.

[Wm.7] Contract of wood betwixt the Marquis of Montrose and John Grahame 1705.

[Wm.8] Appretyatione of the woods of Monteath and Buchanan 1710.

[Wm.9] Contract of wood betuixt the Duke of Montrose and John Graham 1710.


[Wm.11] Contract betwixt the Duke of Montrose and John Irvine and John Smith, 1718.


[Wm.13] Contract of wood betwixt his Grace the Duke of Montroses Commissioners & Wright & caurs 1728.

[Wm.14] Division of the woods of Monteith in three parts. (c.1704).

[Wm.15] Division of the woods in Monteith 1734 in three parts.

[Wm.16] (Division of the woods in Menteith, c.1734).

[Wm.17] Contract of the woods of Menteith and Buchanan betwixt his Grace the Duke of Montroses Commissrs and Powysde Ser & YouF 1735.

[Wm.18] Report anent the woods in Monteith and Buchanan 1740. (enclosed in Wm.20).

[Wm.20] Memorandum reports &c anent the Dukes woods 1743.

[Wm.21] Report Alex Wright and Andrew Fairly anent the woods of Craiguchty and Milnton 7th Feby 1743.


[Wm.23] Contract for the woods in Monteith left uncut by Powsyde 1743.

[Wm.24] Memo. anent the Duke of Montroses woods in Monteith now to be sold, 1743 (enclosed in Wm.20).

[Wm.25] Mr. Drummond's appretiation of the woods in Monteith 1744.


[Wm.27] Contract betwixt the Duke of Montrose Commissioners and John Blair wood of Blarinross 1744.

[Wm.28] (Articles of roup of woods in Monteith, 1748).


[Wm.30] Agreement with Duncan Stewart for the woods of Culgart, Glaschyl and Portnellan 1750.

[Wm.31] John Graham's appretiation of the woods of Monteith within mentioned 1752.

[Wm.31a] Andrew Carrick and James Strathy's opinion of the wood in Monteith 1752.


[Wm.34] Copy letter from the Duke of Montrose to Baillie Dreghorn 1761.

[Wm.35] Answer to the Smithfield Companys petition 1761.

[Wm.36] Partners of Smithfield manufacturing 1764.

[Wm.37] (Letter, Graham of Orchill to the Smithfield Company, 1764).
Buchanan documents (Wb.)

[Wb.1] Contract betwixt the duke of Lennox his commissioners and Duncan Macfarlane for the woode of Inchcallich 1647.

[Wb.2] (Letter, J. Buchanan to the marquess of Montrose, 1705).

[Wb.3] Copy memorial & proposals for John Muirhead in relation to the woods of Buchanan 1757.

[Wb.4] State of the tenants of Craigroston with regard to their barren timber, 1758.

Documents relating to other baronies (Wx.).

[Wx.1] Agreement between the Marquess of Montrose and Auchenedin 1698.

[Wx.2] Agreement betwixt Orchill & John Muirhead anent the hazell of the wood of Mugdock 1754.

GD.248 Seaforth muniments.

Other material in the Scottish Record Office:

RH.2/4 Customs and Excise records: Customs import and export ledgers, Scotland, 1755-1827. Photostat copies of volumes held in the Public Record Office.

SC.54 Records of the sheriff court of Argyll at Inverarary.

SC.54/12: documents registered in the register of deeds and protests.

SC.54/12/7.

[a] Contract of woods between Allan McLean of Ardgour and Colin McAllister in Tarbert in Kintyre, 1713. Registered October 2 1714.


SC.54/12/9.


SC.54/12/10


[b] Protest by Patrick Campbell of Barcaldine against Arthur Galbraith and Roger Murphey, 1723. Registered January 24 1723.


SC.54/12/11

[a] Protest by James, brother to Patrick Campbell of Barcaldine, against Arthur Galbraith and Roger Murphey, 1725. Registered June 24 1725.


[e] Consent of sale and discharge; Arthur Galbraith and Roger Murphey to Charles Armstrong, 1726. Registered July 30 1726.


[g] Protest by Charles Coyle against Charles Armstrong, Arthur Galbraith, and Roger Murphey, 1727. Registered April 3 1727.
Protest by James, brother to Patrick Campbell of Barcaldine, against Arthur Galbraith and Roger Murphey, 1727. Registered April 7 1727.

SC.54/12/12

[a] Agreement between Arthur Galbraith and two tenants in Glen Orchy, 1726. Registered July 4 1730.

[b] Protest by Alexander Cameron of Glen Nevis against Roger Murphey and John MacLachlan, 1730. Registered January 19 1731.


NATIONAL LIBRARY OF SCOTLAND (NLS).

MS.33.5.16 Discourse anent the improvements may be made in Scotland for advancing the wealth of the kingdom. Manuscript pamphlet by Sir Robert Sibbald, 1698.

MS.993 Contracts and miscellaneous letters and papers relating to Lorn Furnace, 1752-1813.

MS.994 Letterbook of the Lorn Furnace Company, August 13 1786 to January 18 1791.

MS.995 Letterbook of the Lorn Furnace Company, January 10 1791 to December 28 1812.

EDINBURGH UNIVERSITY LIBRARY (EUL).

Athole Papers:

Dc.I.37 1/3 Proposals for the improvement of the regality of Atholl. Presented to his Grace in the year 1708. By ----.

NATIONAL REGISTER OF ARCHIVES (SCOTLAND). (NRA)

NRA.0006 Handlist of the Argyll muniments at Inveraray Castle.
Maps, atlases, and plans referred to in the text are here divided into two groups, printed and manuscript material. Those belonging to the first category are described in text references by author and date, with the addition of the suffix 'm' to the date; manuscript maps are described by their pressmarks or catalogue numbers. The only exception is the Military Survey, which remains in manuscript in the British Museum but is here included in the first category. Because of the value of the survey photocopies are held by a number of archives and libraries, and it is therefore considerably more accessible than most manuscript maps; the guide numbers which accompany most references to the survey in the text are those of the sections into which the body of the survey has been divided for photographic purposes. It should be noted that the titles of cartographic agencies and other bodies are abbreviated in text references but given in full below; as a matter of convenience the abbreviation is repeated in brackets after the title in each case.

PRINTED MAPS AND ATLASES


COWLEY, J. (1734m) Map of such part of his grace the duke of Argyle's dukedom and justiciary territories ... as lye contiguous upon the western coast of North Britain. 1:440,127. London.

DORRET, J. (1750m) A general map of Scotland and islands thereto belonging. 4 sheets. 1:250,000.
GRASSOM, J. (1817m) Map of the county of Sterling. 4 sheets. 1:42,220.


LANGLANDS, G. & LANGLANDS, A. (1801m) A map of Argyleshire taken from actual survey. 4 sheets. 1:126,720.


MILITARY SURVEY (M.S.) (1747-55m) No title. Fair copy of northern Scotland. 1:36,000. (BM(N)) Pressmark: K.Top.48.25-1b,c).


ORDNANCE SURVEY (OS) (1953m) Vegetation: Reconnaissance survey of Scotland. 1:625,000. Chessington.


ORDNANCE SURVEY (OS) 1" (Var. dates) First edition of the Ordnance Survey topographic maps of Scotland, 1:63,360. Sheets numbered in a Scottish series. Dates are those of first publication. Southampton.

ORDNANCE SURVEY (OS) 6" (Var. dates) First edition of the Ordnance Survey topographic maps of Scotland, 1:10,560. Sheets numbered in county series (A - Argyllshire, P - Perthshire). Dates are those of first publication. Southampton.


MANUSCRIPT MAPS AND PLANS

Scottish Record Office (SRO).

RHP.747/1. STRACHAN, T. (1858) The lands of Inverscadale, Strongrigan, and others. 1:41,000.


RHP.3480. LESLIE, J. (1756) Map of the barony of Strowan, one of His Majesty's annexed estates in North Britain. 1:21,120.
RHP.4300. LANGLANDS, G. (1777) The united parishes of Killean and Kilchenzie taken by order of the heritors thereof. c. 1:10,000.

RHP.6796. ANON. (c.1745) No title. A sketch plan of the head of Loch Leven and Glen Coe. c. 1:60,000.

National Library of Scotland, Map Room (NLS(M))

Ems.b.4.3 Manuscript maps attributed to Timothy Pont (photocopies). Probably late sixteenth and early seventeenth centuries.

13. A description of Maimoir in Lochabir wt. the placis adiying. c. 1:79,000.

21. The draught of Strath Erin be Mr. Timothee Pont. c. 1:126,720.


Case 8A.2. Manuscript maps by John Adair.

2. (c.1683) The mappe of Straithern, Stormont, & Cars of Gaurie, with the rivers Tay & Ern. c. 1:126,720.


British Museum, Map Room (BM(M))


K.Top.50.69 EDGAR, W. (1745) A new and correct map of Perthshire. c. 1:150,000.