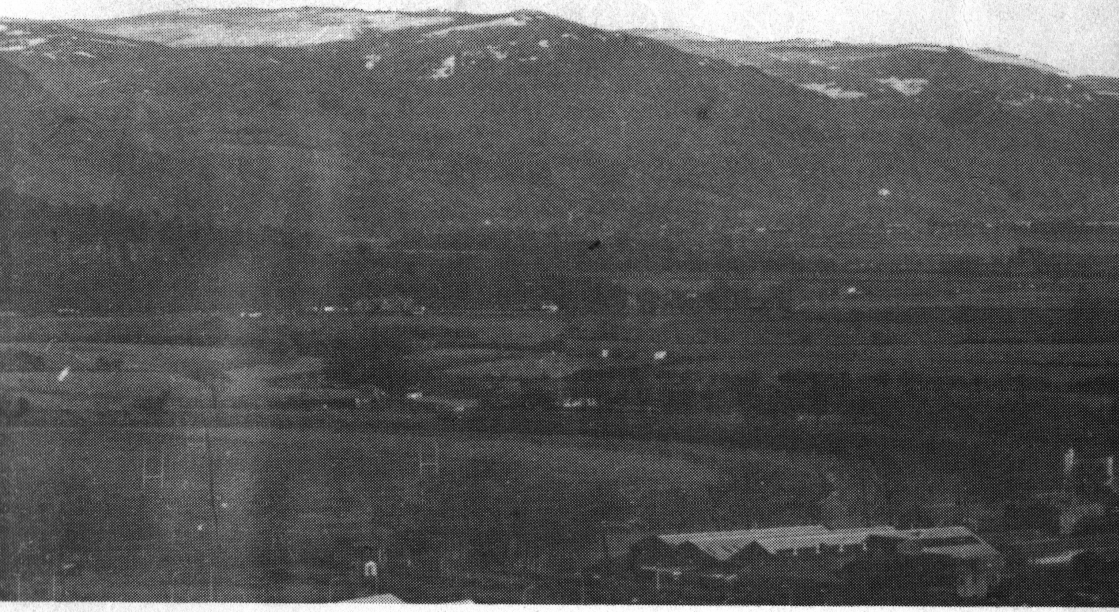
the Forth Naturalist & Historian



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EDITORIAL

The Transactions of the Stirling Natural History and Archeological Society ceased at the outbreak of the Second World War and were never revived. The first widely available publication since 1939 that drew together a range of contributions from the Stirling region was the survey, edited by Professor Timms, which was produced for the visit of the British Association to Stirling University in 1974. This survey, despite its shortcomings, must represent a landmark in the study of our region. Its main message for many was that the Scottish Central Region is as interesting as any area of Britain and yet has received relatively little recent attention. There is a need to revive the type of local studies carried out in the late nineteenth century and first decades of the present century, when men of immense scientific standing, such as Harvie-Brown, Kidston and Buchanan White, as well as many less famous authors, published papers concerned with our region. However, much has changed since their times, both in the region itself and in the range of new information and techniques available to the investigator. The missing ingredient has been the enthusiastic amateur naturalist and historian.

There have been notable exceptions but, even for these, there has been no suitable local journal in which to publish in full their researches and observations. The University community reinforces these studies but it is pleasing to note that the band of amateurs is growing once more and they contribute the majority of papers in this first volume. The interest of the Central Regional Council in this journal is very encouraging and we also feel there is great scope for school projects. The editorial board would like to extend an offer of assistance to school teachers, and others, who would like to consult us about their investigations. It is our intention that each volume of this journal should contain papers from a range of subjects. The preponderance of ornithological articles reflects the skill and enthusiasm of our local bird watchers but such a balance of subject matter is not fixed and we envisage that it will change as the journal evolves. Our aim in launching the "Forth Naturalist and Historian" is primarily to increase our knowledge of a neglected part of Scotland. We hope that by providing a vehicle for publication we will not only stimulate existing workers to present their results but also encourage others to take up new researches.

THE GEOMRPHOLOGY OF THE UPPER FORTH VALLEY

J. B. Sissons

The upper Forth valley contains a considerable variety of landforms and possesses excellent examples of certain types of feature. It includes the largest area of almost flat ground in Scotland, yet this is overlooked by the abrupt, in places precipitous, slopes of the Ochil, Gargunnock and Fintry hills, while the Highland edge is not far away. Erosion by ice-sheets has been extremely effective in the area, producing deep basins whose floors extend well below present sea-level, yet thick deposits of glacial debris occur in places. The ground of intermediate altitude, situated between the steep hill slopes and the almost flat axial belt, has often been moulded by the ice into streamlined forms, with the drumlins around Bannockburn as the prime example. The largest end moraine in Scotland encloses the western end of the Forth lowlands. The results of glacial river action, both erosional and depositional, are evident in many localities, and are represented by meltwater channels, kames, kame terraces, kettles and outwash spreads. The central tract comprises a sequence of estuarine and beach deposits that accumulated during and since the decay of the last ice-sheet and provides the most detailed evidence yet available in Scotland of sea-level changes during this period. As in the rest of Scotland, except for the most recent period very little is known of the sequence of events that led to the production of the present landforms. The intensity of glacial erosion strongly suggests that the area has been covered by ice-sheets on more than one occasion, but there is currently no direct evidence for multiple glaciations in the upper Forth valley. That the area was overwhelmed by successive ice-sheets can be inferred only from evidence farther afield (e.g. in East Anglia and the English Midlands). The evidence for preglacial events is extremely scanty and very few researchers have attempted to interpret this evidence. Consequently this contribution must deal very briefly with landform evolution through millions of years and will concentrate on the events of the last 13,000—13,500 years, for which a considerable body of information is available.

PRINCIPAL RELIEF FEATURES

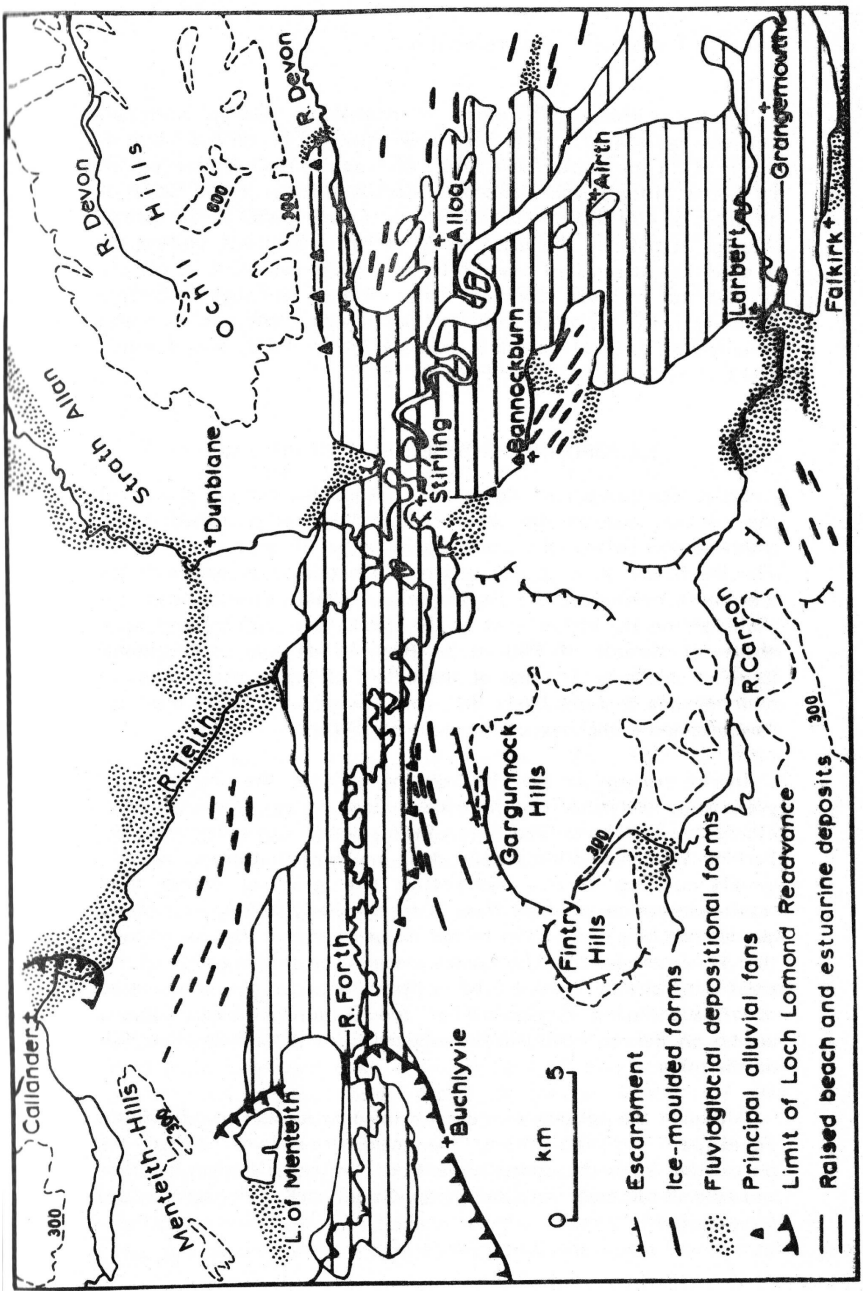
In the upper Forth valley, as in the Central Lowlands of Scotland as a whole, relative relief is closely related to the resistance to erosion of the vari-

ous rocks. In general the igneous rocks constitute the higher ground and sedimentary rocks the lower ground (although one sedimentary rock group is exceptional). The Ochil Hills are composed of a succession of Old Red lavas, tuffs and agglomerates with an estimated total thickness of 2,000 m: the abrupt southern termination of the hills is a fault-line scarp, controlled by the Ochil Fault, which juxtaposed the volcanic rocks and weak Carboniferous sediments. The Gargunnock and Fintry hills are part of another resistant mass of lavas and associated rocks, in this instance of Carboniferous age. Both uplands have extensive areas of peat, but craggy lava outcrops are common especially on steep slopes, the successions of steps that tend to be associated with the lava beds being particularly evident on the steep northern face of the Gargunnock Hills.

The Stirling gap corresponded initially with a narrow belt of sedimentary rocks between the two volcanic masses, a belt whose weakness was enhanced by the presence of the Ochil Fault. In its present form the gap is considerably fortified by the Stirling sill, a sheet of igneous rock, faulted portions of which are crowned respectively by Stirling Castle and Wallace's Monument. The same resistant rock forms the small hill of Craig Forth that rises sharply from the flat ground just west of Stirling, while considerable portions of the sill, again broken by faults, form conspicuous cuestas on the rising ground to the south (Fig. 1).

The low ground extending east and south-east from Stirling accords with the outcrop of weak Carboniferous rocks comprising shales, mudstones, sandstones, fireclays and coals. Prominent relief features related to variations in rock resistance are lacking, although sandstones form various minor features. West of Stirling Old Red sedimentary rocks predominate: they underlie the Carse of Stirling and also form most of the ground that rises southwards to the base of the lava scarps of the Gargunnock and Fintry hills as well as the hill country between the carse and the Highland edge. Generally the Old Red strata are relatively soft sandstones and mudstones and correspond with rather smooth slopes lacking distinctive features, but as the Highland edge is approached layers of conglomerate composed of debris from the Highlands become thicker and more numerous. Consequently the landforms become more varied and the rocks as a whole increasingly resistant so that they form irregular uplands as, for example, the Menteith Hills.

Fig 1. Landforms of the Upper Forth Valley


Callander
300
Menteith Hills
L. of Menteith
R. Teith
R. Forth
Buchlyvie
Strath Allan
Dunblane
Ochil Hills
R. Devon
R. Devon
600
200
Stirling
Alloa
Bannockburn
Airth
Larbert
Grangemouth
Falkirk
R. Carron
Gargunnock Hills
Fintry Hills
300
0 km 5
Escarpment
Ice-moulded forms
Fluvioglacial depositional forms
Principal alluvial fans
Limit of Loch Lomond Readvance
Raised beach and estuarine deposits

metamorphosed grits constitute the peaks of Ben Lomond, Ben Ledi and Ben Vorlich. Erosion surfaces, interpreted as related to relative stillstands between periods of uplift, have been mapped in various parts of Scotland. In the upper Forth area such mapping has been carried out by Soons (1958), who claimed to identify surfaces in the Ochils at altitudes of 460-580 m and 230-300 m. Cadell (1886) in the earliest attempt at detailed drainage reconstruction in Scotland, plotted the original headstreams of the Forth as flowing eastwards across the present site of Loch Lomond. Later workers, although sometimes differing in their reconstructions of past drainage patterns, have also favoured an original eastward drainage in the Forth area (Linton, 1940, 1951; Bremner, 1942; Forsyth, 1970).

LANDFORMS PRODUCED BY ICE-SHEETS

Striae, ice-transported stones and ice-moulded features show that the ice that covered the upper Forth valley was nourished in the south-western part of the Grampian Highlands (Francis et al. 1970). The ice flowed in a general eastward direction in accord with the movement over most of the Central Lowlands. Erratics from the Highlands on the highest part of the Ochils (over 700 m) and striae above an altitude of 900 m on Ben Vorlich give only minimal ice-sheet thickness. In view of the extent of the ice-sheets when at their maxima it seems likely that, over low ground, the ice may well have attained a thickness of the order of 1500 m.

In its passage across the volcanic uplands the ice breached pre-existing watersheds to produce through valleys (Linton, 1963). Thus Glen Eagles and Glen Devon form a continuous valley while the Endrick Water and River Carron drain another. Strathblane, with its gently-curving course reflecting the gradual change from south-eastward to eastward flow, is a particularly striking example of glacial breaching and relates to the major ice-stream that issued from the valley now occupied by Loch Lomond. The erosive ability of this ice-stream is also seen in the contrast between the pronounced north-west-facing escarpment of the Gargunnock-Fintry-Campsie upland on the one hand and the subdued form of the Kilpatrick Hills on the other.

Although the uplands were overwhelmed by ice and specific routes developed through them, the major ice-streams utilised the pre-existing lowlands, especially the Forth lowland. Between the carse and the escarpment of the Fintry-Gargunnock hills ice-moulded landforms show that the basal ice-

flow was north of east gradually changing to east (Fig. 1). Around Bannockburn the drumlins point south-eastwards. In the ground around Alloa and Kincardine the ice-moulded ridges and hollows mostly trend south of east. South of the Kilsyth Hills and Falkirk an extensive area has been transformed by the ice into a succession of ridges and hollows trending north of east. Although most of these various ice-moulded features are partly composed of glacial till (and a few appear to be entirely composed of it, with a maximal recorded depth of 50 m) this is often only a surface layer of limited thickness that masks an erosional topography in bedrock.

A specific example of such an erosional landscape was described by Linton (1962). He maintained that the resistant Old Red conglomerates of the Menteith Hills partly protected the relatively weak sandstones on their lee side from glacial erosion, producing a "tapered interfluve" between the Forth lowland and the Teith valley. In the immediate lee of the Menteith Hills the sandstone interfluve is 5-6 km wide and rises to an altitude of about 150 m, but east-south-eastwards (the direction of ice flow) it gradually narrows, meanwhile diminishing in altitude to about 30 m over a distance of 10 km. Linton referred to the low divide that separates the Forth and Loch Lomond drainage between Buchlyvie and Drymen as a "bridge interfluve". He argued that, although eroded by ice, this interfluve survived since it lay between the routes of major ice-streams. On the basis of such evidence Linton suggested that 100-120 m of rock has been removed by ice from 100 km^2 of the Forth valley west of Stirling. However, this estimate did not take into account the evidence for erosion below present sea-level.

Boreholes along the line of the new road across the carse west of Stirling reveal a broad basin whose rock floor descends below sea-level. Farther west several scattered boreholes prove thick drift, the deepest passing through 120 m before entering bedrock at 109 m below sea-level (Francis et al., 1970). Since rockhead even in the deepest part of the Stirling gap is well above this altitude a closed rock basin is demonstrated. There are no deep bores over much the greater part of the basin: hence its greatest depth may well considerably exceed the maximum so far found.

Down-valley from Stirling the rock "surface beneath the carse is usually below sea-level and beneath the lower Devon valley descends far below. Here numerous bores prove the presence of a deep trench that runs parallel

with the base of the Ochils, the lowest known point landforms show that the basal ice-flow was north of east gradually changing to east (Fig. 1). Farther down the Forth valley boreholes along the line of the Kincardine Bridge and others in the vicinity show that here rockhead descends to no more than 21 m below sea-level (Sissons, 1969). Downstream from the bridge, however, rockhead falls again, this time to a long trench that underlies the Firth of Forth and the northern part of Grangemouth and continues eastwards beneath the Forth past Bo'ness. At one point the rock floor of the trench has been encountered at 206 m below sea-level, although beyond the Forth Bridges rockhead rises to about 60m. Downcutting by ice amounting to at least 140 m is thus demonstrated, but the full amount of glacial deepening is probably far in excess of this figure.

GLACIAL EVENTS

Evidence outside the upper Forth valley suggests that the last ice-sheet began to build up around 25,000 B.P. (radiocarbon years before present) and reached its greatest extent about 18,000 years ago. That the ice had wasted away by about 12,500—13,000 B.P. is implied by radiocarbon dates of plant remains from present and former lake sites at several points in and adjacent to the Highlands. One of these sites is located in the Teith valley a short distance downstream from Callander: here the basal peat in a kettle hole gave a date of 12,750—120 B.P. (J. J. Lowe, pers. comm.). At another site, located near Drymen, the basal organic material yielded a date of 12,510-310 B.P. (Y. Vasari, pers. comm.). If valid, these dates are minimal for deglaciation of the Stirling area: one therefore suspects that deglaciation occurred about 13,000 to 13,500 B.P.

There followed a period of milder climate — the Lateglacial Interstadial — and this in turn was succeeded by a return to cold conditions when glaciers built up again in many parts of the Highlands and at various localities in the Southern Uplands. The limit of this Loch Lomond Readvance is represented by end moraines in the western part of the Forth lowlands and near Callander (Simpson, 1933; Thompson, 1972). In the former area the Menteith moraine can be followed, apart from one break, for 20 km from Port of Menteith, past Arnprior and through Buchlyvie and subsequently at increasing attitudes on the hill slopes to the west, where it dies out at about 250 m. On the high ground it is merely a low mound but on the low ground it varies from a prominent steep-sided ridge (as along the eastern side of Lake of

Menteith) to a belt of mounds several hundred metres broad and up to 30 m high (as near Buchlyvie). On the low ground the moraine is usually composed of water-transported sand and gravel or of ice-transported marine clay that contains numerous shells and shell fragments. Shells from the moraine have been radiocarbon-dated at 11,800—170 B.P., implying that the readvance took place during the cold period that occurred between about 11,000 and 10,000 B.P.

Pollen and stratigraphic studies of the deposits in kettle holes and at the margins of present lakes have the same implication. At such sites outside the readvance limit there may be found below the Postglacial deposits a threefold Lateglaciai sequence comprising an organic layer between minerogenic layers. At similar sites within the readvance limit this Lateglacial sequence is absent. Pollen analysis shows that the organic layer relates to a period of relatively mild climate and corresponds approximately with the Lateglacial Interstadial, the overlying minerogenic layer indicating cold conditions associated with the Loch Lomond Readvance. Such pollen studies have been made for two sites in the Teith valley immediately outside the Callander moraine and for Loch Mahaick to the east, as well as for a site on high ground north of Drymen, all these sites having the Lateglacial deposits. At a site just inside the readvance limit in the Teith valley and at Gartmore within the Menteith moraine the Lategiacial sequence has not been found (Donner, 1957; J. J. Lowe, pers. comm.).

FLUVIOGLACIAL LANDFORMS

A variety of landforms was produced by glacial rivers during ice-sheet decay and in association with the glaciers of the Loch Lomond Readvance. Only the principal areas with depositional landforms are shown in Fig. 1.

Meltwater channels abound on the hill slopes north of the Teith valley and along both flanks of Strath Allan. Although some individual channels and parts of some other channels run straight down the local slope, the majority descend obliquely, falling in a general easterly direction in accord with ice-sheet wastage towards the west. The floor of Strath Allan is extensively covered with sand and gravel forming kame-and-kettle topography, indicative of deposition by glacial rivers amidst stagnant ice, meltwaters escaping eastwards through a deep rock-cut channel that leads into the Earn valley (Sissons, 1961); subsequently meltwaters flowed to the Forth valley along the

gorge-like channel of the Allan Water situated between Dunblane and Bridge of Allan (Forsyth, 1970). Kames, kettles and terraces formed during ice-sheet decay extend along the Teith valley east of the Callander moraine: many are currently being destroyed by gravel workings and some have been completely removed, the gravel being of high quality owing to the abundance of Highland material.

Meltwater channels are common in the hills south of Stirling, some unusual ones having been described by Read (1956). Fluvioglacial deposits occur at various locations on the surrounding low ground of the Forth and Carron valleys: they will be considered below since they are related to raised beaches.

As mentioned already, fluvioglacial deposits are common in parts of the Menteith moraine, which is also cut through by a number of large meltwater channels. Within the morainic arc Lake of Menteith occupies a large kettle hole, while west of the lake is a considerable area of fluvioglacial deposits. Within the Callander moraine terraces formed during the initial stages of ice decay following the maximum of the Loch Lomond Readvance contain kettle holes, but outside the limit kettle holes are lacking (Thompson, 1972). The terrace deposits have been traced for 12 km down the Teith valley to the edge of the carse, beneath which they are continued by a fan of gravel covering an area of at least 18 km^2 (Smith et al., in press).

Fans of a different type that occur at the southern foot of the Ochils may be conveniently mentioned here. They include the large alluvial fans on which Menstrie, Alva and Tillicoultry are built. While the fans are obviously related to the sudden reduction in gradient encountered by streams descending steeply from the Ochils, the apparently limited modern accumulation on them and the fact that they pass beneath the surface of the carse suggest that they are essentially fossil features. Like other fans shown in Fig. 1, they may well have been largely formed at the time of the Loch Lomond Readvance when frozen ground, accelerated frost action and spring snow melt would have favoured their rapid accumulation.

RELATIVE CHANGES OF SEA-LEVEL

The floors of the deep rock basins that underlie the Forth lowlands are often covered with glacial till. This is a thick layer in parts of the Grangemouth area, a depth of 56 m having been bored through at one point.

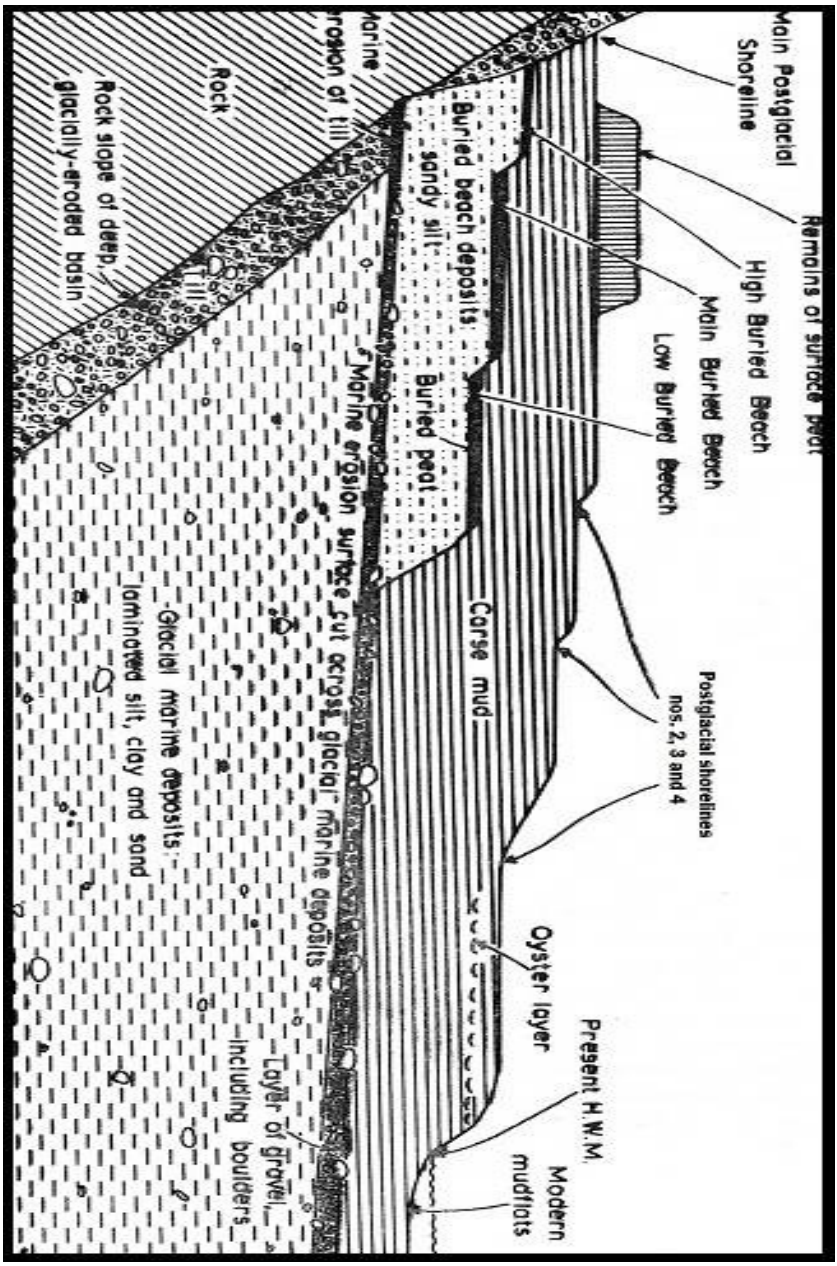
Generally, however, the till is of limited depth and the major infill of the basins is marine and estuarine deposits that in places exceed 100 m in thickness. Much the greater part of these deposits accumulated during ice-sheet decay, demonstrating the vast amount of fine material that was being supplied by glacial rivers at that time. These glacial marine deposits typically comprise thin layers of silt and clay separated by delicate partings of fine sand, but they also include stones and boulders that were dropped from floating ice.

The glacial marine deposits also mantle the lower slopes of the Forth lowland down-valley from Stirling, forming raised beaches. As the former ice-sheets limits are approached the raised beaches become coarser and towards the limits are composed mainly of sand. Such deposits are especially extensive northwards from Falkirk through Stenhousemuir to Larbert, where their surface forms flattish ground at an altitude of about 25 to 35 m. At and near Larbert the raised beach deposits merge into gravel outwash spreads, these in turn giving way westwards to kame terraces, kames and kettles extending along the Carron valley. Together these features show that, when they were being formed, the margin of the ice-sheet was situated near Larbert, the extent of the raised beaches being attributable to the large volumes of debris-laden meltwater that were being discharged from the ice.

The shoreline of the highest raised beach at Larbert is at about 36 m. Like all other raised shorelines in the Forth valley it slopes down eastwards, a consequence of the recovery of the earth's crust from differential depression by the weight of the ice-sheet. (The greatest depression, and hence the greatest uplift, was in the heart area of the ice-sheet in the South-West Grampians in Rannoch Moor and vicinity.) For example, the shoreline is at only 23 m near the Forth Bridges. It can be traced almost continuously northwards from Larbert (e.g. through Glenbervie golf course). As Plean is approached the shoreline forms the margin of broad spreads of sand which, at Last Plean, merge into a gravel outwash spread. This evidence shows that, during part of the time the ice-margin stood near Larbert (the ground to the west being ice-covered) the margin of a tongue of ice that occupied the Forth valley was located between East Plean and Bannockburn (Sissons and Smith, 1965a). Subsequently the margin of the Forth ice tongue stood in the Stirling gap. On the southern side of Stirling (Torbrex, Cambusbarron) kames and kettles are succeeded eastwards by an outwash plain that (at St. Ninians) merges with a broad sandy raised beach that forms a prominent feature

alongside the A9 road and continues through the lower part of Bannockburn. On the other side of the Stirling gap a former position of the ice margin at the base of the Ochils is marked by a kame terrace that slopes down south-eastwards in the grounds of the university, this being succeeded by kame-and-kettle topography. Although the raised shoreline between Stirling and Bannockburn is at 37-38 m, the highest comparable feature immediately west of Stirling attains only 23 m, implying a considerable relative drop of sea-level while the ice margin stood at the Stirling gap. Farther west raised beaches above the level of the carse plain are very fragmentary and their altitude is only about 20-21 m. There is thus a pronounced contrast between the areas down-valley and up-valley from Stirling, the former having extensive raised beaches associated with ice-sheet decay and the latter having hardly any. In both areas, however, as mentioned already, there was abundant deposition of fine sediments in the rock basins. The shells in the Menteith moraine show that the Lateglacial sea extended to the head of the Forth lowlands. The relative lowering of sea-level initiated while the ice margin stood at the Stirling gap eventually brought the sea to about its present level. There then occurred a period of marine planation, the evidence for which is most detailed in the Grangemouth-Falkirk-Airth area (Sissons, 1969). In this area numerous boreholes put down through the carse muds show that the glacial marine sediments have been extensively planed to produce a surface that slopes down gently towards the Forth (Fig. 2).

Locally glacial till and bedrock have also been cut across by the sea. Planation over an area of 28 km^2 has been established but the total amount in the Forth valley westwards from Grangemouth must far exceed this figure. The planation surface is usually covered by a bed of gravel (including many boulders), partly a result of erosion (e.g. of the glacial marine sediments with their ice-rafted debris) and partly supplied by rivers. Since the erosional feature passes beneath the buried raised beach deposits (see below) formation in Lateglacial times is implied. The remarkable extent of the feature in relation to the sheltered nature of the area probably reflects the unusual climate at the time of the Loch Lomond Readvance, when permafrost apparently extended down to sea-level (fossil frost wedges have been seen near Larbert and Stenhousemuir) and storms appear to have been more frequent than at present.


Main Postglacial Shoreline
Remains of surface peat
High Buried Beach
Main Buried Beach
Low Buried Beach
Buried beach deposits:-
sandy silt
Buried peat
Carse mud
Marine erosion surface cut across glacial marine deposits
Marine erosion of till
Rock
Rock slope of deep, glacially-eroded basin
Glacial marine deposits:-
laminated silt, clay and sand
Layer of gravel including boulders
Postglacial shorelines nos. 2, 3 and 4
Oyster layer
Present H.W.M.
Modern mudflats

Following the erosional phase, during the later part of which (at least) there was a relative rise of sea-level, deposition once again dominated and a group of three beaches was produced. Each of these beaches has a bed of peat on its surface and this is covered by the carse muds (Fig. 2): hence the beaches are referred to as "buried beaches" and they have been investigated by putting down numerous boreholes (Sissons, 1966f 1969, 1972; Kemp, 1971). The High Buried Beach is the least extensive but has been traced intermittently from the lower Devon valley to the Menteith moraine. It is present immediately outside the moraine, where it partly rests on outwash that was deposited by meltwater rivers that breached the moraine, but is absent inside the morainic arc. This indicates that the beach ceased to be formed while the ice stood at the moraine, probably between 10,300 and 10,100 B.P.

The Main Buried Beach, which is the most extensive of the three buried features, in places exceeds a kilometre in width and has been traced almost continuously from near Gartmore (for it is well developed within the Menteith morainic arc) to near Airth. Its shoreline, like other former shorelines in the Forth valley, falls in altitude eastwards. The gradient is not uniform, however, and at a point a few kilometres west of Stirling and also at the Menteith moraine there are small but abrupt changes in the altitude of the shoreline, showing that differential uplift was not always a simple tilting. Pollen analysis shows that the base of the peat resting on the beach contains evidence of saltmarsh vegetation, implying that the peat began to accumulate as the sea withdrew from the beach (Newey, 1966; Brooks, 1972). Analogy with radiocarbon-dated pollen sites outside the Forth area suggests about 9600 B.P. as the age of the beach.

The third beach of the series — the Low Buried Beach has been identified at various places along the Forth valley westwards from Airth. The upper part of the beach and the peat overlying it are well exposed at several points in the banks of the Forth downstream from the Menteith moraine. Pollen analysis of material from one of these sections demonstrates saltmarsh conditions at the base of the peat followed by freshwater marsh and this in turn by woodland (visibly represented by tree trunks in the peat), this sequence indicating a relative lowering of sea-level, the sea becoming restricted to the now-buried channel of the Forth (Newey, 1966). A radiocarbon date indicates that the Low Buried Beach ceased to be formed about 8800 B.P. The upper part of the same peat bed shows a return to freshwater marsh, and

then to saltmarsh as it merges into the overlying carse mud. A radiocarbon date of about 8300 B.P. from this upper saltmarsh layer gives the approximate date of marine transgression at the site and indicates that the change from a falling to a rising sea-level occurred about 8500 radiocarbon years ago.

The carselands are mudflats that have been raised above sea-level. They are similar to the mudflats that can be seen today along the coast around Grangemouth, except that the surface metre or so has dried out to form a firm crust. Although the carse plain extends for nearly 50 km and averages more than 5 km in width the deposits are normally only a few metres thick, exceeding 10 m only towards the Forth, where they become increasingly mixed with sand. The deposits often contain much organic material, especially plant remains, and have also yielded the remains of 15-20 whales, up to 20 m long, some of which have been found well to the west of Stirling. Marine shells are rather scarce in much of the carse deposits but in the Grangemouth-Airth area they are very common: here they include a very well-defined bed of oyster shells that slopes gently towards the Forth. The surface of the carse (excepting "the low-level carse extending from Grangemouth to Airth) was once largely covered with peat up to about 6 m thick and peat is still extensive in the western part of the Forth lowlands (e.g. Flanders Moss). Removal of the peat by man has been in progress for centuries (and continues today at Letham Moss near Airth) so that the present sharp boundaries of the mosses are almost entirely artificial.

Deposition of the carse mud began about 8500 B.P. as the sea began to rise from the minimal level referred to above. Although. The land was still recovering from the effects of depression by the weight of glacier ice, the sea rose rapidly in relation to it (demonstrated by radiocarbon dates of the buried peat where this peat merges upwards into the carse clay), a result of the rapid final melting of the North American and Scandinavian ice-sheets. Radiocarbon dates of the base of the peat that overlies the carse clay in West Flanders Moss show that by about 6500 B.P. sea-level had already begun to fall again relative to the land (Sissons and Brooks, 1971).

As shown in Fig. 2 the normal sequence of deposits over much of this carse plain is surface peat (where not cleared by man), carse clay, buried peat and buried raised beach deposits. However, in two areas in Flanders

Moss, each about 1 1/2-2 km across, this sequence does not apply for the carse clay is absent, being replaced by peat: thus peat extends from the ground surface down to the surface of the buried beach deposits (in both instances the Main Buried Beach). The implication is that in these two areas peat growth was sufficiently rapid to keep pace with the deposition of carse mud that accompanied the rising sea-level (Sissons and Smith, 1965b). The presence of this thick peat has locally determined the limit of peat removal by man.

The maximal level achieved by the Postglacial sea is represented by the Main Postglacial Shoreline marking the usually sharp edge of the highest part of the carse plain (Fig. 2). The shoreline reaches its highest altitude of 15 m by Gartmore and overall declines in altitude down the Forth valley (e.g. it is just below 13 m at Stirling) but the slope is not uniform. Subsequently, as sea-level fell intermittently to its present level, shorelines were formed at lower altitudes, three having been identified by Smith (1968) along the northern side of the Forth lowland.

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THE RETURN OF THE HEN HARRIER

Edward A. Blake

INTRODUCTION

The past four decades have seen many changes in the avifauna of Scotland. These include the addition of a number of new breeding birds, an increase in abundance and distribution of a good many species, while in a few cases, a contraction of range has been observed (Parslow, 1973). Few, however, can compare with the dramatic come-back on the mainland, staged by the Hen Harrier Circus cyaneus during the 1940-45 war and the post-war years.

In a short period, it increased from a state of comparative rarity and localised occurrence, to one of widespread distribution and was by 1945-1947 or even earlier, a common bird of prey in some areas, this being especially true of the moorland fringe of the southern Grampians, and was nesting freely within most Highland counties from Caithness to the northern reaches of the Midland Valley.

I will attempt to explain in this article how the Hen Harrier was so successful in its initial spread and final re-establishment within the country generally, beyond our limits and, more locally, within the confines of the Forth basin. The complete relaxation of keepering on grouse-moors in the years of war, allowed the Hen Harrier the necessary respite in the first instance, while the co-operation and understanding of the Forestry Commission and certain other enlightened land-owners in subsequent years, has been largely responsible for allowing it to consolidate its status in the suitable habitat on the Scottish mainland, with overall numbers at present comparable with those of the early 19th century.

The temporary cessation of keepering in the recent war, benefited not just the Hen Harrier, but other raptors and carrion-eaters. This was especially the case with the Buzzard *Buteo buteo* and Golden Eagle *Aquila chrysaetos* which regained much of their former status, although neither was originally so reduced in number as the Hen Harrier.

Alarm among sheep-farmers in Argyll, resulted in a post-war campaign to reduce the Buzzard, while the Golden Eagle having realised saturation point, had not only occupied former Sea Eagle *Haliaetus albicilla* habitat, but spread into south west Scotland and eventually to the north of England and Antrim in Northern Ireland. Among the corvids, the Raven *Corvus corax* made the most spectacular revival, it increased several fold. Hooded and Carrion Crows C. *corona*, likewise multiplied, all three forming large roosts. As late as 1953, the greatly reduced Raven and Carrion Crow roosts in the old, possibly Caledonian relic, pine forest at Braco in south Perthshire, still held fully 300 birds, comprised of equal numbers of both species.

DISCOVERING THE HEN HARRIER

It was late in the day when it came to the notice of most birdwatchers, that the Hen Harrier had effected a general come-back, and the locality in which I discovered my first nest, in Glen Artney in 1951, was but a small pan of a vast area (the most westerly extension of the entire heather grouse-moor of south Perthshire) where it hid 4-6 years previously, regained its former status, but had since gone into marked decline due to renewed persecution. The grouse-moor was seldom visited by the ornithologist in those days, and so the events leading up to the finding of my earliest nesting pair, are worth recalling. At that time, I had been bird-watching for little more than a year, and I still regarded the Hen Harrier (as the text book implied) as extinct as a regular breeding species, and while the locating of my first pair and later, their nest, was an adventure, the first disclosures, not surprisingly, met with some scepticism.

Although future work on the Hen Harrier was to entail countless observations, the very first sighting was to leave an indelible impression in my mind. It was 28th October, 1950, at Aberlady Bay on the outer Firth of Forth. An immaculate silvery-grey male made a sudden appearance from behind a dense thicket of Sea Buckthorn Hippophae rhamnoides, on the fringe of a fresh-water marsh, close by the sea. It hovered momentarily and not many seconds after, weaving through a tall spinney, was gone. A fleeting glimpse, of what was probably a bird from the continent, since Hen Harriers comparatively rarely turn up on the eastern seaboard of Scotland.

The next encounter was on more likely ground. On 3rd March, 1951, an

adult female or ringtail in hunting flight, sailed low over the reedy marshes that border Loch Mahaick, 210 m up on the Braes of Doune, scattering the Mallard present. This was the first clue to the possible local residence of the harrier, and confirmation came from the local sheep-farmer. He had seen it some four years previously and a former game-keeper had often spoken of its presence.

I did not see a Hen Harrier again until a spring day found me to the north west, 13 km removed from the last venue. Some 920 m high on Stuc a' Chroin, I was descending scree on the mountain flank when in the depths of the Dubh Choirein, some 450 m below, and near the head of the glen, was a male Hen Harrier skimming the brown peat-hags. Within the space of seconds, I was incredulous to see it suddenly borne aloft with extraordinary swiftness, wings sharply inclined, as caught up in a rising warm air current, in what seemed as many seconds, it appeared as a speck in the blue, lost to the naked eye. Shortly, it reappeared gliding steeply downward, and with the impetus gained in a dive, swept as before low over the dark valley bottom, seeking accurately the same spot, where once again it was carried aloft with the same phenomenal speed, only this time higher still and swallowed in a white cumulus cloud. I considered the date, the 28th April, too late for a bird of passage or one wintering. Furthermore, the terrain looked suitable for nesting.

That was on the Tay basin side of the watershed. A fortnight later, I walked the hills from Callander to Loch Earn and back. The Common Gulls Larus canus had recently returned to nest at the high lochan on the ben, and a thin cornice of snow persisted on the rim of the east corrie of Stuc a' Chroin. It was late evening, on the return journey, when a cock Hen Harrier was seen hunting the banks of a burn. This time, the harrier was within the Forth basin — at the foot of the great ridge that forms part of the northern boundary to the Forth catchment. It came as not the least surprise, when a shepherd in the passing, told me he had found a nest with 6 young, the previous year, 1950. He and his father had been tenant sheep-farmers for the past three years and the harriers were "always around", indeed two nests had been found in a previous year. The young, however, had all been destroyed.

Locating the harriers' nest in wild undulating country, where the going is

heavy amongst heather, was, at first, difficult. Intuition eventually led me to the spot where almost a month later than average, the hen was to lay. I later calculated that she laid the first of a clutch of five eggs, four days after my first search (on the 13th May) had led me along a parallel series of long folds in the brown moorland, to where I looked out across a wide valley flanked by numerous hummocky glacial moraines. On the top of one of these gravel and sand, heather covered mounds, the hen was to lay. Below where I stood the pair hunted in typical leisurely manner, gliding and flapping alternatively as, low to ground, they followed every contour. Earlier that evening an immature male had appeared in the vicinity. He was not to be seen again that year, nor was the most remarkable observation of this incursion into the domain of the Hen Harrier — the cock was seen swallowing frog-spawn from a water-hole in a mossy spring outlet, throwing his head back repeatedly as he gulped the slimy mass.

Although the food-pass, in which the cryptically plumaged hen is lured off the nest to take the offering some distance away and generally in the air, is obviously a measure intended to safeguard the eggs or brood, the conspicuously coloured male is a give-away at other times. In the presence of an intruder, he will on occasion, dip low over the sitting hen, thus betraying the position of the nest. The increasing attention paid to the searcher by the cock harrier is his worst failing as so it was when on the 24th June I found the nest. Finally, his dives came within four m of my head, and there, two and a half m away, was the hen brooding the nestlings, the youngest two days old and the oldest of four buff tinged downy chicks, six days of age, also an addled egg. Our gaze had hardly met, when, in a flash she was off and in as little time as it took to mount a short height and bank, bore down on my stooping figure, narrowly missing me with out-stretched raking talons. Both parents, brown, checkered hen and silvery-grey cock, then came at me in quick succession, stooping from above, when I felt the waft of their passing, or coming in wild rushes with wings brushing the heather, to rise over my head in the last instant. Meanwhile, the adults kept up a repetition of angry calls. The females cry of resentment, a loud chattering "kik-ik-ik-ik-kik-kik-kik", while the male, an octave lower, gives vent to his feelings with a nattering "kek-kek-kek-kek-kek-kek".

While the male was a comparatively young bird, possibly about three years old (judged by the traces of brown on the coverts and the barred outer

tail feathers), the female was at least six years of age — the time it takes for this sex to acquire a yellow iris (Balfour, 1970). Her age made it all the more difficult to understand the lateness in nesting, but it could be attributable to a new mate, a late arrival on the scene, or even a second laying due to earlier interference, which would not be surprising, judged by the past treatment. Hen Harriers, although ground nesters, build a more or less substantial structure, averaging several cm deep, and this was no exception. In rank Ling *Calluna vulgaris* it was constructed of the same and lined with shortened lengths of the rush *Juncus effusus*. The young I find are not precocious like other moorland ground nesting raptors, Merlin *Falco columbarius* and Short-eared Owl *Asio flammeus*, which wander at an early age. On the contrary, young Hen Harriers remain in the nest until all but fledged, or even to a point where they are fully developed and quite capable of flight.

The 15th July found the three oldest fledglings, all males, among the heather in proximity to the nest; the eldest, now twenty-seven days old, could flutter a short distance, and, little down still clung among his dark brown feathers. Long after her nest-mates had flown and deserted the immediate nest area, the youngest occupant, a female, remained in the nest when fully fledged with not a trace of down. When thirty-six days old, she proved so docile, that, mounting my lowered bare hand, I was able to lift her clear of the nest, and she remained thus perched for several minutes before a quick thrust forced the young harrier to take wing. And, capable of flight at that, she flew a good twenty odd m before ploughing into the heather. Her strong attachment to the nest is shown by the fact that the following day, the 29th July, she was back in the nest! Pellet ejecta showed that 'recent prey had included Pipits *Anthus pratensis* and young Rabbit *Oryctolagus cuniculus*. Three weeks later, when the harriers had vacated the neighbourhood, the only evidence of recent kills was the pluckings of pipits.

In the following year (1952), the laying was a month earlier: the first egg of a clutch of six had been laid by the 20th April or perhaps a day before. The retiring behaviour of her mate, however, suggested that he was a different cock. Only 16m from the previous year's, the new nest was on the slope of the next drumlin, in tall heather as before. Nearby were the recent feather pluckings of two adult Rid Grouse *Lagopus lagopus scoticus;* the harriers clutch as yet incomplete. On the 19th May, I found the nest emptied of its contents, but the hen still hung around and called. The hen, thereafter, de-

serted the locality, although a male (presumably the same) performed his switchback advertisement display in the vicinity, when seen a week later.

As soon as I had confirmation that the Hen Harrier was breeding on sheep cum deer cum grouse moor, the newly formed Scottish Rare Bird Protection Committee pleaded with factor, keepers and shepherds alike, not to interfere with the harriers, on the grounds that they were doing no harm; that in the long term they would prove beneficial (they were of course not protected by law in 1952).

The plea was to no avail, however, because a year later, the gamekeeper molested the nest. Nevertheless, this was not the last of the Hen Harriers in Glen Artney. In 1964, twelve years later, some 600 m to the north of the old site, another old hen elected to nest in knee-deep ling, atop a slight rise on an extensive heather flat. She too, had been a late starter, with the first of a clutch of five, laid on the 22nd May. The reason was there to see: a late mating, the male was a first year ringtail, still in brown juvenile plumage with the only hint of grey, that of the two new inner primaries on each wing, and those, still growing in. That was on the 1st July; five weeks later, he was moulting heavily, a very piebald bird, now a mixture of brown and grey, and like his spouse, left with only three outer primaries on both wings. Nevertheless, he proved a very efficient hunter, and one evening I saw him bring in four kills in the space of two hours, with two young to feed (the remaining eggs were, two addled and one buried in the nest foundation). In 1967, there was still only the one pair. The '64 pairing evidently had not augured well for the following years. This, too, was a late nesting; the first egg of a clutch of six, was not laid until the 24th May, the product of a different hen; a young bird, none the less, she reared and brought off four juvenile harriers.

HABITAT, FOOD AND BEHAVIOUR

In Britain, the Hen Harrier is generally found nesting from near sea-level (on raised-bogs, or occasionally on sand dunes) to c.350 m or more. Ling-Heather is the dominant vegetation of the general habitat, whether it be the mainland or the Orkneys, and is that most often used for nest-cover on the mainland. Purple Moor-grass *Molinia caerulea* is the grass most often associated with the nest-site, and if on a peaty flat, as occasionally it is, then Bog

Myrtle *Myrica* gale may fringe the nest. In east Sutherland, the moors are largely grass-sedge and at Minard in Knapdale, the nest has been located among tall grasses. The Orkney moors provide more variation and are productive of many flowering plants: here the harrier frequently nests among rushes *Juncus effusus*; while Ling is otherwise usually present, pure or mixed with rush, such as Woodrush *Luzula sylvatica* and Horsetail *Equisetum arvense* may brighten the nest-site. Once I found a nest of young, couched among Eared Willow *Salix aurita*. Local material is used for the nest, usually with Ling as a foundation, and rush, bracken or a mixture of two or more (once the defoliated twigs of Cross-leaved Heather *Erica tetralix*). It is usually sited on a slope of moderate inclination, sometimes on a flat or mound and occasionally on a very steep angled hillside, of as much as 30°. The cover may be knee-high or rank of growth.

By extraordinary coincidence, the colonies in Kintyre and near Aberfoyle, although some 89 km apart, were both largely located on identical strata, a coarse, granular quartz schistose rock that occurs along the line of the Highland Boundary Fault, and gives rise to bold features, including steep outcrops, and with similar plant cover dominated by Ling and Purple Moor-grass. In both localities, the harriers were nesting at the same altitude c.150 — 200 m. A remarkable feature of the Aberfoyle moor was the number of Grasshopper Warblers *Locustella naevia*. The latter were few at Carradale, and in neither place, were prey for the harrier, but the Kintyre plantings (unlike Aberfoyle) were rich in Lesser Redpolls *Carduelis flammea*. They were frequent, as were Twites *C. flavirostris*, among the food of the Carradale Hen Harriers, in addition to Meadow Pipits and Field Voles. This abundant and diversified food supply, enabled the harrier to nest in unequalled density, with from 9 to 13 pairs in the years 1960-64 (except 1962 — a year of diminished food supply and inclement weather) concentrated within 2.5 km, on the fortress-like schistose "Deer Hill", the remainder, well spaced outliers, on non-schistose Highland strata.

The Meadow Pipit provides the bulk of the feathered prey of the mainland harriers in the summer months. Rearing of the young is possibly geared to coincide with the peak production of fledgling and juvenile pipits, as it is they that largely fall victim to this surprise hunter — the ground skimming harrier. Fledglings of other species are also taken. The young of Red Grouse however seldom featured in the prey taken by Kintyre harriers

(their density here being very low), but they formed a more significant contribution eastward, more or less supplementing the diet of Central Scotland birds, and if anything, grouse are even more prevalent in diets of harriers of the east Perthshire and Aberdeenshire uplands. Variation in diet is as might be expected, mammalian prey items ranging in size from Field Vole *Microtus arvensis* and occasionally shrews, to the young Mountain or Variable Hare Lepus timidus. The smallest food item, ants, were consumed in large quantity by a fledgling, when these were thick on the ground at Aberfoyle, their remains being ejected in small round pellets.

Outwith the breeding season, an exodus of small passerine birds occurs, and results in a paucity of the important prey element on moorland, that in turn effects a dispersal of adult as well as juvenile Hen Harriers. When the colonies existed at Carradale and Aberfoyle, very few harriers wintered in the general area of either, even the redpolls vacating the plantings of the former. The winter of 1963-64 was exceptional in that a vole-plague enabled four adults three female and one male to over-winter in the Queen Elizabeth Forest Park, where they established a communal roost within a half km of nest sites of the previous summer. Of 59 pellets collected from the roost, 40 were entirely of Field Vole origin; three of feathered prey and six a mixture of both, including Red Grouse in two. Communal ground roosting is frequent among Hen Harriers (as with other harrier species) outside of the breeding season, but usually occurs more or less remote from nesting areas. A favoured locality, usually a fairly secluded hollow among rank heather or rushes, is used year after year by one or more birds to a varying degree. One such, in southwest Scotland, has been annually frequented by up to 31 harriers (Watson and Dickson, 1972). A Strathallan moorland roost, used by up to six harriers in the winters 1957-65 revealed the large bulk of the food of two females in the winter 1960-61 to consist of Red Grouse, with 46 pellets of Red Grouse origin, 6 of Field Vole and 4 of Red Grouse plus Field Vole. This was the more remarkable in view of the vole-plague that winter, with the harriers crossing and re-crossing vole infested grassland each day, between roost and grouse-beat. Of 17 pellets examined at this roost the following winter (1961-62), 7 were entirely of Red Grouse and 2 included grouse. Thus the large potential prey-range of the Hen Harrier is certainly contracted for some individuals in winter, as exhibited by the above two females, who preferred to ignore both vole infested and nearby arable land. What is most surprising, is the fact that the grouse exceeds the weight of the female har-

rier (519 g average. Schauf and Balfour, 1971). Red Grouse vary in mean weight from 556 g for a young hen in a poor season, to 707 g for an old cock in a good year (Jenkins, Watson and Miller, 1963).

A Hen Harrier has been known to lift a fully grown duck (Griffiths, Bundy and Kinsey, 1954), probably a Wigeon *Anas penelope*, from the sea in mid-December, and carry it struggling for c.10 m. A most extraordinary attack, was that of a Hen Harrier that fixed on to a wild grey goose over the Kintyre peninsula in the winter of 1961-62, bringing it down into the gorge of a small moorland burn. When the three witnesses arrived on the scene, the harrier flew off, and the goose, little worse for its ordeal, was retrieved from the stream and carried home. When nesting, the female generally receives food brought in by the male, by aerial pass, either catching it in mid-air, as happens most frequently, or from foot to foot. Sometimes the exchange takes place on the ground. Adults are often given to attack man in defence of their young, the hen bird frequently striking an intruder repeated blows on the head, while the aggressive disposition of the Hen Harrier is sometimes shown in the juvenile instinctively swooping at humans in the vicinity of the nest. Unmated mates will readily construct cock-nests that may later be used as a roost. The advertisement display flight of the male, however, provides the most spectacular behaviour to be seen among most, if not all, birds of prey. The cock having towered high, performs a "switchback" in which he steeply rises and falls in wild abandon, wings assisting, and sometimes executing a backward somersault at the apex of the climb, meanwhile reiterating a far-carrying chatter.

STATUS AND COLONISATION

Early History

Mention of the Hen Harrier in Scotland goes back to at least 1684, when Sibbald referred to it (after Baxter and Rintoul, 1953). Pennant (1789) recorded it breeding in Orkney and other islands in his 1771-76 tour. The Old Statistical Account (1791-99) makes few, although widely scattered references to it, while alluding to the Hen Harrier as a bird of the Campsies, and the commonest bird of prey at that time (1795) in the Kilsyth district.

In the early 19th century, it was still a widespread, common breeding

bird of moorland, from Wigtown and the Cheviots northward to Shetland. There is no direct evidence to support this contention, but an abundant habitat without the destructive interests of game preservation, would probably have allowed the harriers to nest freely. Bewick (1847) said it bred on most moorland areas of northern Britain, while MacGillivray (1836) said "though nowhere very common, is generally dispersed, and in some districts, pretty numerous in the breeding season". As the Hen Harrier does today, he referred to its nesting on moors. Jardine (1838-42) remarked that old and young frequented the moors by day, with regard to Dumfriesshire.

Early agricultural advancement could have deprived the Hen Harrier of certain peripheral breeding sites, as latter day burning and conversion of heath to sheep pasture must also have done, this would have merely displaced the species, because of an abundant alternative environment, and had only a small effect on overall population numbers. The establishment of the new practice of game preservation, especially that of grouse management, brought about the decline of the Hen Harrier and precipitated its destruction to an alrming degree. It is a tale of appalling slaughter, in which the Hen Harrier shared the fate of other predators. None were accorded any quarter, with gun, trap and poison used extensively. These attitudes, one would like to say were those of a past age, but they have changed little since the era of wholesale extermination of raptors, carnivores and carrion-eaters.

The campaign against the Hen Harrier got under-way early in the last century, and by mid-century, such a toll had been exacted, that in the space of a few decades, the harrier had been reduced from a common, widespread resident to one of great rarity throughout southern and eastern Scotland. Heather country, the nesting and hunting ground of the harrier, had been declared "grouse-moor", and many birds of prey had been eliminated on the moors that radiate from the Tay, Forth, Solway and Clyde basins, the Tweed river system and others to the west, east and north-east. Harvie-Brown (1906) wrote "*the Hen Harrier had become quite a rarity in the Lowlands; and long before 1880 ..... it may be considered to have been extinct, certainly as a breeding species*". Certainly, it became at the most a very sporadic nester in the third quarter of the 19th century, and in the last quarter of the same, there are apparently no records of mainland nesting south of Banff (i.e. outwith the West Highlands where it was extremely rare by then), in which county it was rare enough to mention a pair breeding in

1884. Most of what is known" of the early history of the species is told in detail by Baxter and Rintoul (1953), this account relying, very extensively, on that work. Estates kept so called "vermin" records, lengthy lists that would seem often exaggerated, bearing in mind that gamekeepers were rewarded 'by their employers. It is not surprising, considering the army of gamekeepers and methods employed, that very quickly the Hen Harrier on the mainland, was banished to the more remote, less-keepered tracts of the northern counties.

In Caithness it was reputed to be the commonest hawk next to Kestrel *Falco tinnunculus* and Merlin in 1868; however, its predestined rarity before the turn of the century was indicated when Harvie-Brown and Buckley (1887) wrote that it still bred in the remoter southern reach. It was rare before 1880 in Wester Ross. In his notes of the period 1881-87, Booth said "*a few pairs may still be found scattered over 2 the flat moors*" of east Sutherland and adjacent Ross-shire. By 1887 it had become very local in west Sutherland and was last recorded there in 1894, in Assynt.

By the turn of the century, the Hen Harrier had been reduced to a state of, virtual if not complete, extinction as a breeding bird on mainland Britain, having suffered the same fate in its more restricted, although neverthless widespread breeding haunts in England, but probably beginning earlier in the south. Meanwhile, the same process of extermination by human persecution, resulted in a rapid decline of the species towards the end of the century in Ireland, where, by 1913 or thereabouts, it was considered as no longer nesting, although authorities differ in their opinion of exact status.

Some of the more remote islands around Scotland, were to remain the last strongholds of the Hen Harrier, in a few of which, it has continued to breed until this day — they were in fact the saving grace of the species. Some sixty years after its extirpation on the adjacent mainland, even the island of Arran in the Firth of Clyde knew the Hen Harrier as a regular breeder up until 1912. Its fate had been sealed much earlier in the Inner Hebrides — on Skye, the gamekeeper had finally exterminated" it by 1889; on neighbouring Raasay, before 1899, while on Mull, it was scarce by 1892. Once common on Skye and Mull, no doubt it was more so on Lewis in the Outer Hebrides, aptly named Eilan a' Fraoich, the 'island of heather' but here too, it was doomed soon after being reported "*tolerably abundant*", at least

locally, in 1879. At the other end of the long archipelago, it still bred in North Uist as late as 1931. The bog-maze of South Uist, was however, to retain the Hen Harrier as a breeding bird in spite of the depredations of the unscrupulous egg-collector who had played his part in the demise of the species on the mainland, and at least helped secure its fate on other islands. Although it persists, in more recent times, the harrier on South Uist has reputedly suffered low breeding-success from inbreeding. Orkney may be regarded separately. This close-knit group of islands, has the distinction of having been declared the only official sanctuary for the Hen Harrier, a holarctic species (i.e. one with a circum-World breeding distribution in the temperate and low-arctic latitudes). In the Orkneys, where Harvie-Brown and Buckley had described the harrier as still the commonest hawk in 1891, egg-collectors had reputedly reduced the species drastically by the end of the century. Protective measures were taken only just in time, and even then, it was a long struggle, for, in addition, a conflict of interests arose between the bird-protectionist and the local farmers, for the Orkneys are hen rearing islands.

Recent History

The Hen Harrier is an extensive wanderer outside of the breeding-season, birds from the more northern latitudes vacate their nesting-haunts and are more pronouncedly migratory, but the young from every region are decidedly nomadic from late-summer onwards, and turn up at widely scattered points, sometimes even in the most unlikely places. I found an immature (dark ringtail) frequenting the Edinburgh Royal Botanic Gardens and the adjacent suburban gardens, for fully .a week in October, 1957. The normal winter-haunts are moorland, coastal and to some extent, neighbouring arable land. That there is an interchange between the continent and the British Isles, ringing has proved (Mead 1973) a small proportion of first-year birds departing our shores; while from Europe, England especially receives a regular immigration of birds, no doubt a preponderance of juveniles, but including also adults.

Just how effective were the activities of the keeper and the collector, we shall no more ever know than what the status of the Hen Harrier was at the end of the 1914-18 war, on mainland Scotland, for with the cessation of inter-human hostilities, the ranks of the gamekeeper closed, in the same strength

as before. There are, however, indications that even if not on the scale of the more recent war, a substantial recovery probably took place. Few records are all that there are and can be expected for the inter-war period. There was the 1936 pair that bred in Inverness-shire, while at the other extreme, there was a probable breeding on the Cumberland-Dumfries border in 1925. Betwixt the two, there was the attempted nesting (both adults shot) near Perth in 1922, while the shepherd, who had found several nests prior to me in the late-nineteen forties near Callander, was familiar with the Hen Harrier on the Crieff end of the same hills about 1925, and an acquaintance, walking the wilds of Glen Almond in the mid-thirties, had met with the bird. Rintoul and Baxter (1935) refer to it as a former breeder, but now occasional visitor to the Forth basin.

In England and Wales, the Hen Harrier had bred sporadically early in the present century; according to Witherby et al. (1939) in Cornwall, Hants, Surrey (1932), Anglesey (1924-26), Caernarvon and perhaps Devon. That the Hen Harrier is one of the most successful of predatory vertebrates, with a remarkable propensity to increase and spread given the prerequisites of an adequate potential food supply and open country in which to hunt and good cover for nesting, is illustrated by the 1940-45 recovery on the Scottish mainland. An immediate response to a let-up in supression was apparent, the harrier reacted in what amounted to a population explosion in the peripheral Highland region. The Hen Harrier had to be in fair quantity and scattered in the pre-war years, to account for the widespread recolonisation of large tracts of moorland, in the space of half a decade.

Evidently, it had radiated out from a number of widely separated pre-war centres, between Perthshire and Sutherland-Caithness, and by 1945-47, had indeed realised a peak in numbers, whilst having spread to much of what was suitable terrain (Blake, 1961). By the end of the war, the Hen Harrier was firmly re-established in south to southeast Perthshire; it was once more as common as it had ever been on the big 'grouse-moors' centred on Amulree and Pitlochry, and on these vast areas of rolling heather country, was again, the most conspicuous bird of prey. At this point, the returning 'keepers, although in lesser numbers than before, had begun a further campaign of destruction. Another recession started on the grouse moors of central and east Scotland, and the harriers suffered a marked general decline, possibly as serious as the preceding, becoming quite scarce by the late forties

to early fifties. To convey the scale of persecution; of ten nests reported from widely dispersed areas within the Highland region in 1951, only one was successful, that which I had discovered. Some concept of how scarce the Hen Harrier was in the same year, can be had from the fact that only three pairs had nested in c.180 km² of moorland overlying the Old Red Sandstone that forms the watershed between Tay and Forth basins. In the same area, none nested in 1953-54, and in the latter year, three adult males held summer-territory within a 5 km. stretch of heather along the southern fringe of the same. They displayed with regularity, but to no avail — there were no hens left in a vast tract that had numerous pairs not so many years before.

The attitude of the gamekeeper is reflected in that of the one who keepered Feddal Hill. In the immediate post-war period, for four successive years, a pair had nested and after watching the food brought in, the keeper destroyed the young in three of the nests, when at last, a grouse chick turned up among the prey. By coincidence, in the last year (1952) in which a pair of Hen Harriers was to nest for some years to come in the Callander — Comrie — Braco triangle of heather-moor, a pair of Montagu's Harriers *Circus pygargus* nested on the moorland fringe above Braco. This was the first recorded successful breeding of the species in Scotland: I found their nest barely quarter of a mile from that of the Hen Harrier, and only 10 m from the latter's 1951 nest!

The regenerative ability of the Hen Harrier, is well portrayed in the parallel growth of the Orkney population during the 1940-45 period. In 1941, Lack (1943) found a number of pairs on the main island and two pairs each, on Hoy and Rousay. By the end of war, numbers had greatly increased, and Edward Balfour showed me a stretch of hillside where seven nests were located in the space of 1.6 km. This was the highest breeding density ever to be realised on Orkney; in 1958, the general spacing of nests was 1.6 km. Although Argyll is geographically remote from the original area of recolonisation in the eastern half of the country, and with high intervening mountainous ranges, the Hen Harrier, soon found its way to the western seaboard — a pair were reported from Loch Feochan in north Argyll by 1949, while the first bird made its appearance on the Forestry Commission moorland at Carradale in south Argyll in 1947. The latter was important as it was the forerunner of the largest and most densely populated colony of the Hen Harrier ever to occur on the mainland of Britain. The Carradale colony, in the Kin-

tyre peninsula, was to serve as the main reservoir for harriers colonising the adjacent mainland, i.e. Ayrshire, southwest Scotland and beyond, Arran and almost certainly Ireland. Knapdale in mid-Argyll was colonised too, and here, the bird was well established in the Minard forest plantations in the early fifties. Carradale, however, provided optimum breeding conditions in which 300+ young were fledged in the eight years 1957-64, with a peak density reached in 1961, when 18 pairs bred in 13.5 km^2 (13 pairs nested in 2.5 km^2).

Thereafter, the Hen Harrier spread to other Forestry Commission areas, notably the Queen Elizabeth Forest Park: 89 km. removed from Carradale. The first pair bred in the early fifties, and although a colony was slow to take shape, by 1961, eleven pairs reared 33 young and it had become the second largest breeding concentration on the Scottish mainland, and one situated in the Forth basin, in central Scotland, immediately adjacent to moors on which persecution of harriers continued. In southwest Scotland and the Border counties, it had made its appearance as a breeding bird by the late fifties — 3 pairs at least nested in the latter area in 1960 and 7 pairs bred in one area in the southwest in 1970 (Watson and Dickson, 1972). By 1961, a pair had successfully reared 6 young in Northumberland. In southern Ireland "extensive breeding" had taken place in three counties (Bannerman, 1956) in 1955. Bijleveld (1974) quotes J. Temple Lang that more than 35 pairs of Hen Harriers bred in Ireland in 1967, and also Ruttledge (1966) stated that breeding occurred in at least six counties by 1964.

Initial and latter day expansion is reflected in a number of factors. The average clutch size is 4-6 eggs, with large layings the rule in new areas colonised, and while a high fertility rate is general, if undisturbed by man, a high breeding-success ensues. The latter, dependent on the available food supply was particularly high in the case of the Carradale colony. Young fledged from eggs laid, gave the following percentages: 1957 - c.80%; 1958 - c.85%; 1959 - c.77%; 1960 - c.72%; 1961 - c.72%; 1962 - c.52% and 1963 - c.75%. In the three years 1959-61, only one nest out of 39 failed in this colony.

Some idea of the production of fledged young can be had from the fact that in 1961, the three main breeding areas at that time, i.e. Orkney, Carradale and the Queen Elizabeth Forest Park, between them, produced 155 young flown - 64, 58 and 33 respectively. A large quantity and one that does

not take into account the numerous other widespread broods reared. It represents an average of three young fledged per nest at both mainland stations, but a much lower figure for Orkney.

Apart from man, the Hen Harrier has virtually no natural enemies in the British Isles, and although the eggs are white and the nest on the ground, not one among the very large number of nests I visited in the years 1951-68 was molested by, or sustained loss to, some other animal. The female sits tight and is a more than able defendant of her cares.

In the case of one nest in the Dovrefjell in Norway, however, I found the four near-fledged young, killed by a feral Mink. Lastly, the Hen Harrier was one of our few birds of prey to escape the ravages of toxic-chemicals. While Peregrines *Falco peregrinus*, Sparrowhawks *Accipiter nisus* and Merlins *F. columbarius* (from the same breeding habitat) were being reduced in the late fifties — early sixties, the harrier was actually increasing in number and continuing to recolonise. Two Hen Harriers' eggs from south Perthshire, which were analysed in 1964, showed little and ineffectual contamination. While the Hen Harrier is largely a killer of birds, in Scotland, it subsists to a considerable extent on moorland prey in winter as in summer, and this probably accounts for the absence of an effect of pesticides on breeding success.

Today the Hen Harrier no longer occurs in Forestry areas in the density of the late fifties and early sixties. Nevertheless, the birds continue to nest there, and if not in smaller total numbers, they are certainly more dispersed.

The present status of the Hen Harrier in the British Isles can be summarised as follows:- Widely found as a breeding bird in Scotland, thinly distributed in most areas, but quite common in some Lowland and Highland regions. Snow (1971) and Parslow (1973) reported it nesting in six counties in Ireland, two counties in northern England and one or two in Wales.

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ing a large source of young to replace the losses elsewhere and further extend the harriers range. To the latter day enlightened estate landowners and their employees, we are also grateful.

SUMMARY

An account is given of finding the Hen Harrier nesting in the immediate environs of the Forth basin in 1951 and aspects of habitat, food and behaviour are described. This is followed by a general history of the species within the British Isles — its decline in the last century, subsequent recovery and post-war recession, and more recent resurgence, with a final assessment of its present day status. Factors involved in the successful recolonisation of the mainland of Scotland are discussed.

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HABITAT SELECTION IN THE BIRDS OF WOODLAND AND OPEN WOODLAND OF THE STIRLING AREA

C. J. Henty

INTRODUCTION

One of the most familiar and dramatic phenomena of bird habitat ecology is the fact (e.g. Fisher 1940; Lack 1933) that few of the species characteristic of extensive woods also appear in completely open areas; it is for example most unusual to see a Robin in the centre of a meadow. However when less extreme comparisons are made the picture is far less clear. For example Simms (1971) points out that many of the passerines of suburban gardens are also typical woodland species. Attempts such as the studies of Lack and Venables (1939) or Yapp (1962) to understand the more subtle aspects of the use of wooded areas by different species have often been made difficult because such areas vary in many features — tree species, height and density, features of the shrub and ground strata, altitude, geographical position may all be important.

Whilst studying the summer birds of the Stirling area in 1973 I decided to investigate the bird communities associated with large, old deciduous trees depending on whether the trees were in continuous canopy or interspersed with open grassy areas or clumps of scrub. Hence I made simple counts (line transects) in areas of mixed deciduous woods with continuous tree canopy and also in adjacent areas on the lower slopes of the scarp of the Ochil hills, where there are very open woodlands on grazed pasture with discontinuous scrub, the deciduous trees being scattered or occasionally in lines or small clumps.

STUDY AREAS

Around the foot of the Ochil hills between Bridge of Allan and Alva are a number of woodlands that are not subject to intensive management, e.g. Mine Wood, Abbey Craig Wood, Hermitage Wood, Red Carr Wood and the wooded parts of Menstrie and Balquharn glens. I worked in these woods in areas where mature deciduous trees were in continuous canopy, not taking records from the wood edge or sub-areas with a mixture of conifers or extensive clearings. Red Carr Wood is possibly the most representative, with a mixture of Oak *Quercus robur*, Wych Elm *Ulmus glabra*, Sycamore *Acer pseudoplatanus*, and Ash *Fraxinus excelsior* with a little fringing birch *Betula sp.* and willow *Salix sp.* The shrub layer is composed of tree saplings and a

moderate but patchy cover of Elder *Sambucus niger*, bramble *Rubus sp.* and hawthorn *Crataegus sp.* The woods are generally neither visually open like a plantation of beeches nor thronged with impenetrable thickets. Many of the mature trees have Ivy *Hedera helix* and broken branches and dead trees are not uncommon. Mine Wood has an area dominated by large Beech *Fagus sylvatica* whilst Hermitage Wood has areas with many Sycamores and a fairly dense shrub layer of *Rhododendron sp*. The woods of the glens are small, dominated by Sessile Oak *Quercus petraea* and with *Hazel Cory/us avellana* and Rowan *Sorbus aucuparia*. The very open, savanna woodlands of the grazed slopes have mature trees with the same mixture of species but besides extensive grassy areas there are patches of Bracken *Pteridium aquilinum*, Gorse *Ulex europaeus* and Blackthorn *Prunus spinosa* in addition to the other shrubs.

RESULTS

The relative abundances of the various bird species in the two habitats are presented as percentages in Table 1 and Fig. 1; this allows easy comparisons to be made between species and habitats. The figures include all positive and individually distinct identifications by sight or sound of both adult and immature birds and are subject to the bias of different degrees of conspicuousness. Thus no great faith should be placed on the exact values calculated. My own feeling is that both between species and habitats a difference in relative abundance should not even be commented on unless the larger value is at least one third greater than the smaller.

When relative abundances of a given species are compared between the habitats the figures reflect the relative numerical predominance of that species in the two bird communities but do not give a good estimate of relative densities unless the total densities over all species are similar in each habitat. This assumption is valid for the present study since a trial comparison of number of records per hour shows that the result for open woodland (75 per hour) falls well within the range of samples from Hermitage, Red Carr and Mine Woods (60, 67, 72 and 98 per hour). Hence the relative abundance plotted in Fig. 1 is a reasonable estimate of the preferences of the various species for the two habitats. Most of the species were undoubtedly both feeding and breeding in the habitats studied, however, a few may come into the woodland only to feed — I suspect Greenfinch and Siskin fall into this category — and I have on purpose excluded from the continuous woodland data species that used the woods only for nesting (Rook, Jackdaw, Woodpigeon, Starling). I have experience of both habitats over several years in which no

counts were made, and I believe the only cases where the line transect data are misleading concern a few scarce species. Thus Green Woodpeckers are in general seen as often in the open as the continuous woodland and also there are a few Redstarts in both habitats.

The various individual woods show considerable similarity so I have not set ail the details down here, even the rhododendron areas of Hermitage Wood produce no striking effect on the common species although it does contain all the Chiffchaffs recorded thus confirming the observations of Meiklejohn (1952) and Hope-Jones (1972). In the open woodlands some species show a patchy distribution at a very detailed level. This occurs with Tree Pipits, with Whinchats in some bracken areas and with Yellowhammers in some gorse areas. It is worth noting that careful mapping, in the style of the British Trust for Ornithology 'Common Bird Census', is less subject to biases induced by variations in conspicuousness of different species, but it would be practicable only over fairly small areas and hence one detailed but localised survey could very easily give an erroneous picture of the habitats as a whole.

First consider the species that are numerous, with an average relative abundance greater than 5%. Only Blackbirds have a markedly similar frequency in both habitats. Robins seem rather more frequent in continuous woodland in contrast to Dunnocks, as found by Beven (1973), whilst in species where the difference is marked, Chaffinches, Blue Tits and Wrens predominate in continuous and Willow Warbler in open woodland.

All the above commonest species occur fairly frequently in both habitats and it is only in the less frequent species (relative abundance 2-5% in at least one of the two areas) that we find cases of complete restriction to one habitat. Linnet, Whinchat, Yellowhammer, Starling, Tree and Meadow Pipit were recorded only in the open woodland, but there are no cases of species in this category of abundance that occur only in continuous woodland. The Song Thrush occurs equally in both habitats, like the more numerous Blackbird, whilst Coal Tit, Great Tit and Treecreeper are commoner in the continuous woodland but not dramatically so.

Some of the species that are quite scarce in continuous woodland completely fail to appear in the more open areas. This is most convincing for Wood Warbler and Goldcrest, since in some places outside of the present

transects Blackcap, Garden Warbler, Chiffchaff and Spotted Flycatcher can be found where trees are scattered. Hence although Table 1 apparently demonstrates a total absence of these species from open areas this picture would probably not be so clear cut if much more data were available.

Looking at the common species that make up 75% of the records the present results for continuous woodland agree very well with the extensive studies of Lack and Venables (1939), Yapp (1962), Simms (1971), and Seven (1963). Any one study area nearly always has one or two peculiar features but there is nothing to mark these Stirling woods as being different from woods in southern England except for the absence of geographically restricted species such as Marsh Tit and Nuthatch, and these in any case do not regularly come into the numerous category within their ranges. I do not know of studies in habitats that closely resemble my open woodlands but the information from the British Trust for Ornithology 'Common Bird Censuses' for farmland, quoted in Murton (1971), or for pure scrub areas (Venables 1937; Williamson 1967; Beven 1973) do not overall demonstrate any striking discrepancies when allowance is made for local differences between such studies, or events such as the recent decline in Whitethroats. The Skylark is the only species that is common in nearby treeless areas but is entirely absent from the open woodland. Of the 36 species considered in the present study 14 were recorded in both habitat types, 13 occurred only in open woodland and 9 only in the continuous woodland. If more observations were made then the actual totals would rise in all three categories but the proportions of shared to unshared species would not alter very much since as some quite new species were added to the unshared list some previously unshared species would certainly be found to occur rarely in the other habitat. Not only are there slightly more species in the open woodland but, even allowing for this fact, their relative abundances are distributed more evenly, i.e. putting it the other way, in the continuous woodlands there are more very scarce species. This is shown in Table 2 which was got by arranging the species in order of abundance for each habitat and then calculating how many species were needed to account for various proportions of the total records in that habitat. Table 2 shows that consistently fewer species are needed in continuous woodland. At the rare end of the scale the last 5% of records are made up by 11 species (half the species list) in the continuous woodland but by only 7 species in the open woodlands (a quarter of the species list).

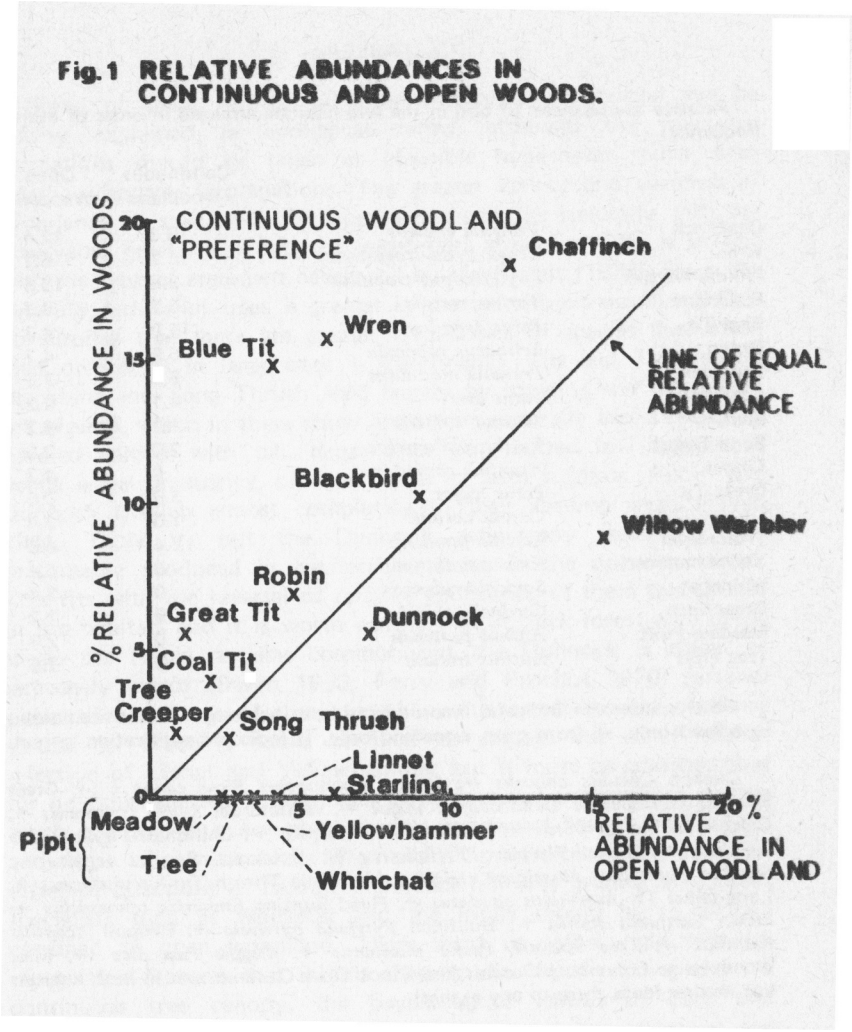

TABLE 1: Relative abundances of bird in the two habitats arranged in order of overall

frequency.

		Continuous Woodland	Open Woodland	
Chaffinch	*Fringilla coelebs*	*18.3*	*12.4*	
Wren	*Troglodytes troglodytes*	*15.7*	*6.2*	
Willow Warbler	*Phylloscopus trochilus*	*8.8*	*15.5*	
Blackbird	*Turdus merula*		*10.2*	*9.3*
Blue Tit	*Parus caeruleus*	*15.0*	*4.3*	
Robin	*Erithacus rubecula*	*6.9*	*4.7*	
Dunnock	*Prunella modularis*	*5.5*	*7.5*	
Coal Tit	*Parus ater*	*4.1*	*2.2*	
Starling	*Sturnus vulgaris*	*(0)*	*6.2*	
Song Thrush	*Turdus philomelos*	*2.0*	*2.5*	
Linnet	*Acanthis cannabina*	*0.0*	*4.3*	
Great Tit	*Parus major*	*3.6*	*0.6*	
Carrion Crow	*Corvus corone*		*1.0*	*3.4*
Treecreeper	*Certhia familiaris*	*2.4*	*0.9*	
Yellowhammer	*Emberiza citrinella*	*0*	*3.4*	
Whinchat	*Saxicola rubetra*	*0*	*3.4*	
Greenfinch	*Carduelis chloris*	*1.9.*	*1.2*	
Meadow Pipit	*Anthus pratensis*	*0.0*	*2.8*	
Tree Pipit	*Anthus trivialis*	*0.0*	*2.5*	

Other species; ++ indicates records from both habitats, - from continuous woodland only, -+ from open woodland only. 0 indicate qualification in text. Cuckoo *Cuculus canorus* -+; Green Woodpecker *Picus canus* + (-); Great Spotted Woodpecker *Dendrocopos major* +-; Whitethroat *Sylvia communis* -+; Garden Warbler 5, *Sylivia borin* +-; Blackcap *S. atricapilla* +-; Chiffchaff *Phylloscopus collybita* +-; Wood Warbler *P. sibilatrix* +-; Goldcrest *Regulus regulus* +-; potted Flycatcher *Muscicapa striata* + (-); Mistle Thrush *Turdus viscivorus* +; Long-tailed Tit *Aegithalos caudatus* -+; Reed Bunting *Emberiza schoeniclus* -+; Siskin *Carduelis spinus* +-; Bullfinch *Pyrrhula pyrrhula* -f; Redpoll *Acanthis ammea* -+; Tree Sparrow Passer *montanus* -+; Magpie *Pica pica* ++; (n.b. Woodpigeon *Columba palumbus* and Stock Dove *Columba oenas* nest in both habitats but neither feeds there to any extent).

TABLE 2: Species diversity patterns; numbers of species required to account for specified proportions of the total population:

	50%	75%	95%	100%
Continuous canopy woodland	4	6	12	23
Open woodland	7	11	20	27

DISCUSSION

Some of these results for summer habitat distribution can be readily explained in ecological terms, although the following suggestions should be taken as plausible hypotheses rather than solidly supported explanations. The greater variety and evenness of abundance of species in the open woodland fits naturally with the observable greater diversity of vegetation structure. This is in line with the type of argument developed by MacArthur (1972). Since the absolute density of trees is greater in the continuous woodlands it is no surprise that there are greater frequencies of species that often feed on insects in large trees — Chaffinches, Tits and Treecreeper. Blackbird and Song Thrush feed largely by foraging and digging on the ground, which in these study areas were generally accessible being covered neither with tall, dense grass nor matted low vegetation, hence equal frequency of these birds in both habitats. Robin and Dunnock overlap almost completely in their feeding areas (Beven 1964, Table V) but the Dunnock eats many seeds that are presumably produced in greater abundance in the open woodland. This fits with the reversal of relative abundance of these two species in the habitats and it is worth noting that in thick forest with dense shade the Robin remains common but the Dunnock is absent or extremely scarce (Beven 1953; Ferry and Frochot 1970; personal observation). The seed story together with a requirement of dense shrubs for breeding could be held to explain the strict habitat selection of Linnet and Yellowhammer but it must be admitted that for no other species do such easy environmental explanations possess much cogency. It is not obvious why two insect feeders of the field and shrub layer, such as the Wren and Willow Warbler, should possess different directions of habitat preference nor why ground level insect specialists such as Whinchat and the Pipits should be so strictly confined to open woodland. There must be rather rigid stimulus recognition features that inhibit these species from residing under a continuous tree canopy, the psychological factors of Lack and Venables (1939), but there must also be underlying ecological and evoluntionary pressures that have brought about these perceptual preferences and aversions. Competition is one possibility and there is an obvious candidate for a Whinchat competitor in the shape of the Robin. In the case of Meadow and Tree Pipits, which both occur in open woodland, there is no obvious competition in the form of a group of ground invertebrate feeders that are frequent in continuous woodland but markedly less abundant in open areas. Possibly the Pipits specialise in smaller insects that are open to view (i.e. not under leaf litter) and hence need a dense but relatively short grass and herb layer. This could explain why the Tree Pipit

can be found regularly in sessile oakwoods that possess a continuous canopy but a thin shrub and an abundant grass or heathy ground (Yapp 1962, Edington 1972).

To analyse the situation further would require detailed information about actual bird densities, feeding activity and food distribution and abundance. However it is worth pointing out that many quite familiar features of habitat distribution are essentially unexplained except in the most simple minded terms (e.g. no nest holes for tits in shrubs) or in terms that include a large element of speculation. Only in a very few cases such as the Treecreeper are there compelling structural reasons why a bird can feed only in trees and not in shrubs or on the ground. The Green Woodpecker, equally at home excavating branches or anthills, is a striking warning against such confident explanation.

Finally it will help to complete the picture by commenting briefly on distribution at other seasons, although my own data is very incomplete on this point. From July onwards a number of species appear in the fully grown bracken on the open hillside. Wrens, Blackbirds, Robins and Dunnocks are not unexpected but there are also many Willow Warblers and occasional Great Tits. Simms noted an early departure of Chaffinches from the woods but in my study areas they are still frequent in October although not in midwinter. At least in mild winters there are in both continuous and open woodland, good numbers of Blackbirds, Robins, Blue and Great Tits. However in continuous woodland Wrens are decidedly scarcer in winter, although still present, and I have the impression that Dunnocks are scarcer in the open woodland. Linnets desert the scrub areas of the slopes, though they may return to roost, and most Yellowhammers move onto nearby farmland. Bullfinches appear more often in winter in both wooded habitats and also higher up on open heather, whilst parties of Blue Tits occasionally appear in gorse areas away from any trees. A surprising variety of birds can in time be found wintering in exposed scrubby woodland between 500 and 1200 feet whilst the odd Wren and Reed Bunting appear even in midwinter in rush beds or scraps of cover up to 2000 feet on the Ochil slopes.

The unmanaged nature of these woodlands, both continuous and open, provide many opportunities for the study of natural history. However the open woodlands are under threat at the moment. Most of the existing trees are mature or aged and with heavy grazing pressure from sheep and rabbits there is little regeneration outside of gorse clumps that themselves suffer periodic burning. Thus removal of trees by windblow and casual felling is

not being compensated by new growth and unless conservation measures are taken soon this attractive habitat will not be around for the benefit of future generations.

SUMMARY

This study investigates the extent to which birds typical of woods require a continuous canopy of trees and conversely how far species typical of open country merely require open spaces rather than positively avoiding the proximity of tall trees.

Line transects were made in early summer in several continuous canopy deciduous woods and in areas of open woodland with grassy spaces and some clumps of scrub. The seven commonest species all occur quite frequently in both habitats and only the Willow Warbler is markedly more frequent in the open woodland. Some moderately abundant species (Whinchat, Linnet, Yellowhammer, pipits) are absent from continuous woodland where the specialist species, mainly Warblers, are in the least abundant categories. The open woodland has more species and their relative abundancies are more evenly distributed. Of locally common species only the Skylark is entirely absent.

Ecological explanations in terms of food are made for some of the distribution patterns and attention is drawn to the curious problem of why Whinchats and pipits are absent from the continuous woodland.

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STIRLING AND CLACKMANNAN BIRD REPORT (1974 &1975)

C.J. Henty

The Scottish Ornithologists' Club organises a system of Local Recorders one of whose duties is to send in a yearly report of bird sightings to the Editor of the Scottish Bird Report. These local accounts serve as the basis of the national report pubashed each year in Scottish Birds and they also act as useful data base. The account presented here is essentially the 1974 and 1975 reports for Clackmannan (C) and East/Central Stirangshire (S) (i.e. the Central Region less Perth county and Loch Lomondside. Yearly reports are already pubashed for both these areas).

The information in the systematic lists of species is in no way a comprehensive account of the complete status of every species, since the original data is biased due to the interests of the observers sending in notes to the local recorder. The summarising of these notes is also affected by the interests of the recorder. The occurrence of scarcer species however is reported in a fairly complete way and so is the non-breeding distribution of waders and ducks. By comparison, information is poor on the status of the commoner residents and there is also a general lack of cover for most of Stirling away from the Forth Estuary.

I hope that in the next few years there will be enough information to produce a comprehensive account of the avifauna and would welcome all notes including those for previous years and especially pre-1965 data that has not been published in Scottish Birds or Rintoul and Baxter's 'Birds of Scotland' (1953).

SYSTEMATIC LIST 1974

BLACK-THROATED DIVER:	S,	pair at a western loch on 11th May, 1 sitting on island in incubation posture 25th May.	(AM, GS) (DMB)
GREAT CRESTED GREBE:	S,	Grangemouth, spring max. 126 on 16th February, autumn max. 151 on 22nd September.	(DMB)
LITTLE GREBE:	S,	20 at Airthrey Loch on 14th March, were probably breeding population; still 4 in December.	(DRW) (GS)

FULMAR:	S,	2 on Forth at Kincardine Bridge on 25th May, 17 on 14th August.	(DRW)
CORMORANT:	C,	22 at South Alloa on 18th September.	(GS)
	S,	67 at Skinflats on 3rd March.	(DRW)
HERON:	C,	1 on Ochils burn at 1,200 feet on 27th January	(CJH)
MALLARD:	C,	pairs widespread in Spring in Ochils up to 1,300 feet.	(CJH)
		421 at Tullibody Inch on 30th June.	(GS)
		230 at Gartmorn Dam on 28th September.	(DRW)
		268 at Alloa on 15th December	(GS)
	S,	160 at Skinflats on 1st December.	(DRW)
		180 at E. Grangemouth on 1st December.	(DRW)
		175 at Airthrey on 11th November.	(CJH)
TEAL:	C,	pair by R. Devon at Alva on 13th May.	(DRW)
		244 at Tullibody Inch on 10th March and 327 on 10th November.	(GS)
WIGEON:	C and S, scarce inland at Gartmorn Dam in winter.		
		38 at Alloa on 17th February – max on Forth above Kincardine Bridge.	(GS)
PINTAIL:	C,	17 at Cambus on 10th March.	(GS)
	S,	66 at Grangemouth on 9th February.	(DMB)
		71 at Skinflats on 15th December.	(DRW)
SHOVELER:	C,	2 at Marchglen pool on 5th May.	(DMB)
SCAUP:	C,	3 males at Tullibody Inch on 21st July.	(GS)
	S,	5 in Grangemouth area on 3rd March.	(DRW)

TUFTED DUCK:	C,	45 at Tullibody Inch on 30th June. (GS)
	S,	probably 4 to 6 pairs bred at Airthrey. (CJH) 363 at Airthrey Loch on 15th January and 168 on 21st December. (CJH)
POCHARD:	S,	12 at Airthrey Loch on 6th and 12th February. (CJH)
GOLDENEYE:	C,	190 at Kincardine on 16th February (DMB) 222 at Alloa on 15th December. (GS)
R ED-BREASTED MERGANSER:	S,	500 It Kincardine Bridge on 17th November. (DMB)
GOOSANDER:	S,	12 on Forth above Stirling on 14th January. (GS) Brood of 6 on Forth above Stirling. (GS)
SMEW:	C,	2 redheads at Gartmorn Dam on 3rd January. (DMB)
SHELDUCK:	C,	Summer: 145 (only 11 few juvs) at Alloa-Tullibody Inch on 30th June (GS)
	S,	Skinflats and E. Grangemouth, 1,020 on 10th February; 1,475 on 1st December. (DRW)
ANSER SP:	C,	do not often feed in Hillfoots/ lower Devon valley, though flocks regularly fly over, often cutting across the central Ochils. (CJH)
	S,	Max: 1,000+ on Carse above Stirling on 2nd February. (PWS)
PINK-FOOTED GOOSE:	S,	1st record at Airthrey on 23rd September.(RT,DRW)
MUTE SWAN:	C,	34 at Cambus on 10th March.
	S,	21 at Cornton on 31st December. (GS)
WHOOPER SWAN:		Largely a terrestrial feeder around Stirling and in Devon Valley, roost on R. Forth or on Gartmorn Dam.

	C, 111 at Menstrie on 22nd December.	(CJH)
	Parties of up to 46 at South Alloa and Cambuskenneth.	(PWS,GS)
	Age composition (% juv): Menstrie 16% (out of 80) on 24th November,	
	15.5%(out of71) on 29th December.	(CJH)
	S, 1 summered on R. Teith with a feral goose.	(GS)
GOLDEN EAGLE:	C/S, 1 over S.W. Ochils on 14th September.	(CJH)
BUZZARD:	S, 2 around Bridge of Allan in April and December.	(GS)
SPARROWHAWK:	C, 3 records of birds hunting over open hills above 1,000 feet in Ochils.	(CJH)
	S, several Pairs around Bridge of Allan	(GS)
HEN HARRIER:	S, 1 male on Sheriffmuir on 25th August and 1 on 27th September	(AM) (DMB)
PEREGRINE:	C, 1 (probably im. male) above Alva on 21st May, 8th June, 14th July (chased Kestrel).	(CJH)
	S, 1 at Skinflats. Jalnualry-March.	(DRW)
	3 records near Stirling and 1 Alloa January-March.	(DMB, (GS,CJH)
MERLIN:	C, male at Forestmill on 20th February.	(TDHM)
	Brown bird at 1,800 feet on 30th November.	(CJH)
	None seen in Spring 1100 Summer during extensive transects of the Western and Central Ochils.	(CJH)
	S, 2 at Skinflats, January-March.	(DRW)
	Autumn: recorded regualrly in September-December at Skinflats	(DRW)
	and Grangemouth including male	(DMB)
	chasing linnets near factory area on 2nd October.	(DRW,TDHM)
KESTREL:	C, Central Ochils, regular in Summer up to 1,750 feet.	(CJH)

None seen in interior of these hills in January-February or November-December. (CJH)

RED GROUSE: C, Central Ochils. January-February and November-December frequent on heather and heather/grass on Alva Moss and Menstrie Moss and Dumyat only 2 records out of 98 on pure rough grass. Summer distribution essentially as Winter, up to 1,800 feet.

S. frequent on Sheriffmuir in July in open spruce plantations (1 - 3 feet and 2 - 6 feed with heather field layer.

BLACK GROUSE: C, in winter widespread and locally numerous in Central Ochils on heather, grass, and open woodland.
Max. 38 at Wood Hill on 3rd February and 21 at Alva Moss on 30th November. (CJH)
Summer distribution similar but fewer on Wood Hill. 1 'roocooing' above Alva Glen 18th May - no regular lek there. (CJH)

S, max. 26 at Sheriffmuir lek on 27th September. (DMB)
Hitherto unrecorded lek on Dumyat - up to 10 males and 1 female in March and May. (DRW)

PARTRIDGE: C/S, throughout the year widespread and frequent on Carseland around R. Devon and on scarp of Ochils to 1,250 feet. (CJH)
Max. covey of 10 on Dumyat on 11th November. (CJH)

C, 11 on King's Seet Hill on 2nd January, on scree at 1,900 feet. (CJH)

CORNCRAKE: S, 2 calling at Carse of Lecropt on 9th May. (DMB)
1 in hayfield at King's Park on 4th June. (AM)

COOT: C, winter maxima: 110 at Gartmorn on 28th September. (DRW)
S, 206 at Airthrey Loch on 15th January. (CJH)

OYSTERCATCHER	C,	spring, 1st heard at night at Alva on 25th February. (CJH) Autumn/winter: seldom seenebove Kincardine Bridge except for a few at Kennetpans (max. 4, on 15th December). (GS)
	S,	spring. 1st heard at night; at Bridge of Allan on 19th February. (GS)
LAPWING	C.	summer : widespread and frequent on cane pasture and arable; scarce on rough grass slopes of the Ochils (which form main habitat between 700 – 1,750 feet but widespread higher up where there is short grass on scarps andridges 1,300 - (CJH) 2,000 feet, 2,500 at Kincardine-Alloa on 17th November. (GS)
	S.	flocks. maxima; 1,400 at Airth on 15th September. (DRW) 1,392 at Skinflats on 15th September. (DRW)
RINGED PLOVER	C.	lit Kincerdine-All0a. singles on 5th-24th May with 1st of autumn. on 21st July. (GS)
	S,	200 at Skinflats on 19th May - a marked spring peak (DMB)
GOLDEN PLOVER	C,	in Ochils in summer; widespread. but restricted to short grass or mixtures of short/rough grass on scarps and ridges 1,400-2,000 feet, usually in close proxiinity to Lapwing. (CJH) spring: small movement, Alloa-Kincardine on 10th March. (GS)
	C/S,	autumn: 444 at Skinflats on 21st July - 25% were in breeding plumage and identifiable as southern race. (DRW) 350 at Airth on 15th September. (DRW) 700 at Tullibody Inch on 17th November. (GS)

GREY PLOVER:	S,	max. at Skinflats, 38 on 24th February; 16 on 28th September. (DRW)
SNIPE:	C,	57 Kincardine-Alloa on 13th October.
	C/S,	spring/summer: widespread and frequent (a) on boggy pasture of Carse in Clacks. and (b) in boggy pasture between 400 - 800 feet in S.W. Ochils (Stirling). (CJH)
WOODCOCK:	S,	roding from 27th February at Airthrey end at least 3 present later in Spring. (DRW)
CURLEW:	C,	frequent in spring in Ochils on both heather hags and rough grass up to 2,000 feet. Leave early hence no July records. (CJH) 216 at Kincardine-Alloa on 17th February. (GS)
	S,	407 at Skinflats on 15th December. (DRW) 400 et E. Grangemouth on 31st August. (DRW)
WHIMBREL:	S,	3 at Skinflats on 16th September. (AB) and singles on 18th August, 21st, 22nd and 28th September. (DRW, DMB)
BLACK-TAILED	C,	2 at Black Devon mouth on 8th September. (GS)
GODWIT:	S,	3 at Skinflats on 23rd March and (DMB) 5 on 24th February and 1 on 10th March. (DRW) In autumn 2 on 6th August and 1 on 15th September. (DRW)
BAR-TAILED GODWIT:	C/S,	max. on Upper Forth (including Culross) 504 on 13th October. (DMB)
GREEN SANDPIPER:	S,	1 at Skinflats on 18th August. (DRW)
COMMON SANDPIPER:	C,	in breeding season on Central Ochils; widespread but not numerous on the larger burns to 1,000 feet. (CJH)
	S,	4 above Stirling on 1st September (GS) the last seen inland. Few passage records: 1 at Airthrey on 28th July, 3at Skinflats on 21st July. (DRW)

REDSHANK:	C,	breeding: Central Ochils, widespread but scarce, highest record at 1,500 feet on wet peat flats.	(CJH)
	S,	maxima: at Skinflats. 1,050 on 24th February; 1,465 on 15th December.	(DRW)
		Inland in Winter: 1 or 2 on the lower Allan in October-December.	(GS)
SPOTTED REDSHANK:	C,	1 at Cambus on 25th April.	(CJH)
		1 at Tullibody Inch on 10th November.	(DMB)
	S,	1 at Skinflats on 24th May. In autumn at Skinflats, 2 on 6th	(AB)
		August, 1 on 18th August.	(DRW)
		1 on 15th September,	(DMB)
		At E. Grangemouth, 1 on 31st August end	(DRW)
		1 on 20th October.	(DMB)
GREENSHANK:	S,	1 at Skinflats on 21st April and 5th May. In autumn at Skinflats,	(DRW)
		2 on 18th August. 3 on 19th September, 1 on 21st September.	(DRW)
		Inland, 1 on Forth above Stirling on 31st July.	(GS)
KNOT:	S,	at Skinflats, max. 9,300 on 2nd February.	(DRW)
LITTLE STINT:	S,	1 at Skinflats on 15th September.	(DRW)
DUNLIN:		No signs ot breeding.	
	S,	at Skinflats, winter max., 4,990 on 2nd February.	(DRW)
		Autumn max., 1,260 on 17th November.	(DRW)
RUFF:	S,	at Skinflats, recorded 6th August - 21st September. max. 5 on 18th August.	(DRW)
		1 at E. Grangemouth on 6th August.	(DMB)
ARCTIC SKUA:	S,	5 at Skinflats on 18th August. flying very high towards Kincardine Bridge, possibly indicating cross country passage Otherwise	(DRW)
		1 on 6th August.	

GREAT BLACK-BACKED GULL:	C,	Central Ochils: patrolled by adults and immatures in winter, max. 7 on 17th February. Also 6 imm. on 19th May and an adult feeding on dead sheep at 2,000 feet on 30th November. (CJH)
	S,	Upper Forth, 25 on 30th June.
LESSER BLACK-BACKED GULL:	C,	1 at Cambus on 10th March. (GS)
	S,	no December or January records. 1 at Bo'ness on 6th February. (DMB) 1 at Stirling on 9th March. (DMB)
LITTLE GULL:	S,	1, 1st summer, at E. Grangemouth on 24th June. (DRW)
BLACK-HEADED GULL	C,	max. at Alloa-Kincardine, 848 on 21st July; 500 during winter '73/'74. (GS)
COMMON GULL:	C,	16 adults around an islet (4 sitting) at Upper Glendevon Reservoir on 15th May. (CJH)
	S,	max. inland 400 at carse on 7th November. (GS)
KITTIWAKE:	C/S,	122 at Kincardine Bridge on 10th March. (DRW)
BLACK TERN:	S,	2 at Skinflats on 15th September, 1 on 21st September. (DMB,DRW)
COMMON TERN:	C,	last record: 1 at Cambus on 13th October. (DRW) "Commic Tern": (presumed Common) 3 sitting on islet at Upper Glendevon Reservoir on 19th May. (CJH)
	S,	30 pairs at Grangemouth on channel markers of R. Carron. (GS)
RAZORBILL:	S,	1 dead (oiled) at Skinflats on 23rd March and (DMB) 1 on 5th May. (DRW)

STOCK DOVE:	C/S, small parties frequent on Carse around Stirling and R. Devon.	
	C, max. altitude, 4 at 1,000 feet amongst dispersed old trees on Wood Hill on 18th November.	(CJH)
	S, 70 flying west at Airthrey on 10th December, an exceptional number.	(DMB)
WOODPIGEON:	C, in central Ochils present in May in narrow but thickly wooded glens. also several above 1,000 feet in open tree and pine/deciduous copses on Wood Hill Alva on 18th May.	(CJH)
COLLARED DOVE:	C, still absent from Alva and doubtfully resident in Tilacoultry.	
CUCKOO:	C, fewer than in 1973 on Ochil slopes above Alva and Menstrie. Several at 1,000 feet on Wood Hill, Alva, on 18th May. (CJH)	
	S, 1st record; Sheriffmuir on 29th April.	(AM)
BARN OWL:	C, 1 at Alva on 28th February. 1 at Cambuskenneth on 13th March.	(DMB)
	S, Adult with 5 eggs at Airthrey on 26th May, 2 young fledged.	(DRW)
TAWNY OWL:	S, nests seen: Sheriffmuir, nest + 3 small chicks on 1st May.	(DRW)
	Kippenreit Glen. Bridge of Allan. 2 fledglings on 11th June.	(DRW)
LONG-EARED OWL:	S, 1 at conifer plantation near North Third Reservoir on 21st June. Sole record.	(DMB)
SHORT-EARED OWL:	C, 1 by Forth near Alloa on 17th February and 15th December.	(GS)
	1 at 1,600 feet, open rough grass in Ochils on 27th January.	(CJH)

	S,	several in summer at Pendreich and Sheriffmuir in conifer plantations.	(GS,CJH)
		Few other records: 1 at Skinflats on 15th September.	(AB)
KINGFISHER:	S,	1 on R. Allan on 3rd November.	(GS)
SWIFT:	S,	1st record, 1 at Airthrey on 9th May.	(DMB)
		last record, 1 at Bridge of Allan on 25th August.	(GS)
GREEN WOODPECKER:	S,	7 counted in 3 km of Ochil slope above Blairlogie on 23rd March.	(DRW)
GREAT SPOTTED WOODPECKER:	S,	Bridge of Allan, bred Mine Wood and by Allan Water, no other records.	(GS)
SKYLARK:	C,	widespread in Central Ochils in Summer, up to 2,000 feet.	(CJH)
		Winter movement: 500 at Kennetpans on 13th January.	(GS)
SWALLOW:	C,	1st record: Menstrie on 23rd April.	(DMB)
		last record: 3 at Menstrie on 8th October.	(DMB)
		Several hawking at 2,000 feet in Ochils on 7th June.	(CJH)
	S,	Pendreich on 30th April.	(AM)
HOUSE MARTIN:	C,	return to breeding colony at Alva on 10th May.	(CJH)
	S,	last date at Bridge of Allan on 18th September, earliest for 3 years.	(GS)
SAND MARTIN:	C,	colony at Alva "quarry" now extinct 11~20 pain in 1972).	(CJH)
		By R. Devon, 36 pain at Alva and Menstrie, 5 pairs.	(DRW)
RAVEN:	C,	probably bred at Craig Leith, (probably pair + 2 juv.) seen on 19th May.	(CJH)

C/S, most other records above 800 feet on Ochils, except at Pendreich on 13th March. (GS)

CARRION CROW: C/S, in summer widespread to 2,000 feet in Central Ochils, in winter absent from interior peat hags and ridges. (CJH)

C, 100 in pre dusk gathering at Menstrie on 2nd November. (CJH)

S, 1 hybrid Carrion/Hoodie at Blairlogie on 14th March, 2nd April, 31st May'. (DMB)

ROOK: C, 70 feeding on rough grass at 1,750 feet, King's Seat Hill on 7th June. (CJH)

S, Rookeries at Bridge of Allan (W. end), no obvious difference from previous years. (CJH)

MAGPIE: S, early spring groups: 12 at Logie on 2nd February, 6 at Blairlogie on (GS) 24th March. (CJH)

JAY: S, several winter and autumn records in Stirling area but few in summer. 1 in July in well grown spruce at 1,000 feet, Sheriffmuir. (CJH) 1 at Mine Wood, Bridge of Allan, on 10th July. (CJH)

GREAT TIT: C, altitude: singing 18th May, and juv. seen 30th July above 1,000 feet in pine/deciduous copses, at Wood Hill, Alva. (CJH)

BLUE TIT: C, 6 at Wood Hill, Alva, on 30th July, in pine/deciduous at 1,000 feet, possibly a post-breeding dispersal. (CJH) A one-legged bird seen at Alva reappeared in the autumn.

COAL TIT: C, 2 on 18th May, 1 on 3rd February, on Wood Hill at 1,000 feet. (CJH)

S, frequent in July in spruce plantation (5+ metre high) on Sheriffmuir at 1,000 feet. (CJH)

TREECREEPER: C/S,probably high populations frequently in deciduous woods around Bridge of Allan and Hillfoots in both July and February (as often recorded as Dunnocks). (CJH)

WREN: C, altitude distribution in Central Ochils: winter. 3 records at 1,100 - 1,250 feet (Jan, Feb, Nov.) all in association with rushes. Summer. mainly in gullies or open (CJH) woodland and spruce plantations. up to 1,000 feet but 2 singing in April and May in gullies at 1 ,200 and 1,300 feet (little or no scrub). Distinct movement into bracken of lower slopes after (CJH) mid-July end some over-winter in this habitat. (CJH)

DIPPER: C/S, not frequent on small, high burns of Ochils, highest February 1,450 feet. April 1,600 feet. (CJH)

S, poor breeding success (very dry April) near Bridge of Allan (GS)

MISTLE THRUSH: C, post-breedlng dispersal: 15 at 1,000 feet on Wood Hill on 30th July. (CJH)

S, song heard at Airthrey on 19th January and at Bridge of Allan on 30th December. (GS)
25 at Sheriffmuir on 18th July. (DRW)
50 to E. over Bridge of Allan on 8th August. (GS)
20 over Bridge of Allan on 16th September (PWS)

FIELDFARE: C, movement: 25+20 to W. at Forestmill on 19th October. (CJH)
10 to W. at Alva on 20th October. (CJH)
15 to W. at Alva on 2nd November. (CJH)
150 at Alloa during January;
300 on 15th December. (GS)

S, last in spring: 200 North Third Reservoir on 18th April. (AM)
164 moved off to E. from Cambuson 21st April. (GS)

C/S, few reports of large flocks in mid-winter except by Forth.

SONG THRUSH:	C/S,	1 egg laid in a Blackbird c/3 at Dollar.	(TDHM)
		"movement" noted by R. Allan and Forth in August/September.	(GS)
		60 at Logie on 21st September.	(GS)
		5 singles by tidebank of R. Forth near Alloa on 15th December, possibly (snow) weather movement.	(GS)
REDWING:	C,	1 in full song by R. Devon at Menstrie on 29th March.	(DRW)
		1st of Autumn: Dollar on 3rd October.	(TDHM)
		Flying W. with Fieldfares near Alloa on 19th and 20th October.	(CJH)
		No large flocks reported in mid-winter.	
	S,	last of Spring: 1, Sheriffmuir on 31st March.	(GS)
RING OUZEL:	C,	breeding; widespread but patchy in scrubby gullies and crags in Ochils.	(CJH)
		No records out of hill regions.	
BLACKBIRD:	C,	overlaps with Ring Ouzel in at least two scrub filled gullies (750 feet) on scarp of Ochils.	(CJH)
		A few appear in hill bracken or thin scrub (where no sign of nesting) as early as May.	(CJH)
WHEATEAR:	C,	in early summer seen up to 2,000 feet in Ochils.	(CJH)
	S,	1st records: Sheriffmuir on 28th March,	(DRW)
		31st March,	(GS)
		1st April.	(AM)
STONECHAT:	C,	breeding: above Alva, a male on 21 st May but no further evidence.	(CJH)
		6 Balquharn Glen on 14th September.	(CJH)
		Winter: not found in winter on gorse slopes above Alva, although seems ideal.	(CJH)
	S,	breeding: 4 fledglings seen on Sheriffmuir on 14th May, where	(CJH)
		a total of 5 pairs bred (1 triple brooded).	(GS)
		Winter: several by Sheriffmuir sites on 18th February and 22nd December.	(CJH)
		Male at Grangemouth on 27th December.	(TDHM)

WHINCHAT: C, habitat on Ochils south slope mainly in bracken but also in open woodland at top of Wood Hill (1,000 feet). (CJH)
Several at Black Devon mouth on 8th September. (GS)

S, 1st record: 1 at Sheriffmuir on 4th May, (breeding site). (CJH)
Also noted by R. Allan on 27th July. (GS)

REDSTART: C, 2 singing at 1,000 feet on Wood Hill on 18th May. (CJH)

S, Bridge of Allan, male on 25th July - however the two sites of 1972 still remain unoccupied. (GS)
Male et Menstrie Glen on 4th MaY. (CJH)

ROBIN: C, in spring on Ochils, in gullies and open woodland to 1,000 feet. (CJH)

C/S, dispersal to open habitats in late summer e.g. juv. by dyke on open moor, Sheriffmuir 14th July. (GS)
1 in dense bracken above Alva on 21 st July. (CJH)

BLACKCAP: C, 2 singing on Wood Hill, on 11th May. (CJH)
Male at Dollar on 16th and 30th November. (DRW,TDHM)

S, 2 sites at Bridge of Allan. (GS)

WHITETHROAT C, 5 males on territories along 3 km of R. Devon from Menstrie-Alva. (DRW)

S, bred at Logie. (GS)

WILLOW WARBLER: S/C, frequent at 1,000 feet in pine/deciduous copses on Wood Hill, Alva, on 18th May, and in open 2-5 metre spruce on Sheriffmuir on 6th July. Disperse into open moor and bracken by mid July. (CJH)
Numbers in August by junction (GS)
of R. Teith and R. Allan. CJH)

S, 1st at Pendreich on 14th April. (GS)

CHIFFCHAFF:	S, 1st record at Bridge of Allan on 3rd April.	(GS)
	Last record by R. Allan on 8th September.	(GS)
WOOD WARBLER:	C, heard during summer in Dollar Glen.	(CJH)
	S, 1st records: at Bridge of Allan on 27th April and 28th April.	(PWS)
PIED FLYCATCHER:	S, 3, pair + male at Bridge of Allan on 28th May, 1 male on 11th	(PWS)
	June.	(DRW)
MEADOW PIPIT:	C/S, breeding: widespread and frequent on Ochils in heathar and rough grass, mainly to 1.soo but a few at 2,000.	(CJH)
	C, 8 on Wood Hill on 18th November.	(CJH)
	Other flocks: 250 at Black Devon mouth on 8th September and 53 on 15th December.	(GS)
	S, still frequent in interior of Ochil hills on 14th September, but later parties restricted to scarp edge. e.g. 40 above Blairlogie on 3rd November.	(CJH)
TREE PIPIT:	C, on Ochil scarp distribution patchy and mainly up to 1,000 feet; 1 in open mature pine at 1,250 feet Wood Hill on 18th May.	(CJH)
	S, 1st record: at Polmaise on 4th May.	(AM)
PIED WAGTAIL:	C/S, autumn movement: parties by Forth at Alloa and Skinflats on 21st July.	(GS)
	S, max. at Bridge of Allan; 300 by floodwater on 31st January.	(GS)

YELLOW WAGTAIL: C, female at Menstrie on 13th May - not seen subsequently. (DRW)

S, female at Skinflats on 17th May. (DRW)

WAXWING: S, 1st report: 4 at Bridge of Allan on 1st November. (RT)
Maxima at Bridge of Allan, 80 on 11th and 30th November. (TDHM, DRW, GS)

STARLING: C, nests in old deciduous trees at 1,000 feet on Wood Hill - 8, carrying food to nest sites, on 18th May. (CJH)
Winter: no huge flocks, 1,400 near Alloa on 13th January. (GS)

GREENFINCH: C, 300 at Gartmorn Dam on 3rd January. (DMB)

GOLDFINCH: S, 3 juv. above Bridge of Allan on 24th July, only breeding record. (GS)
Max., 12 at North Third Reservoir on 31st January. (GS)

SISKIN: Few records:
C, 2 in reeds 8t Kennetpens on 13th October. (GS)

S, 2 at Mine Wood on 17th July. (CJH)
2 in town garden 8t Stirling on 29th September. (AM)
6 at Logie on 22nd September. (GS)

HAWFINCH: S, female at 1973 site (Bridge of Allan) on 30th April, nothing further. (GS)

LINNET: C, notably frequent as breeding species on gorse of Ochil slopes above Alva. (CJH)

TWITE: C, 80 on saltmarsh at Black Devon mouth on 17th November. (GSI

S, 30 at Grangemouth on 9th February. (DMB)

REDPOLL:	Few records.	
	S, max. 40 over Bridge of Allan on 16th January.	(GS)
REED BUNTING:	C, 5 records in Ochils up to 1,850 feet in January and February in rushes and young spruce. Breeding records in Ochils (April/May) show similar distribution.	
SNOW BUNTING:	C, small numbers in Central Ochils at 1,500 - 2,000 feet in January-February and November, max. 45 on 15th December.	(CJH)
	6 on bank of Forth at AIIoa on 15th December.	(GS)
HOUSE SPARROW:	C, semi-albino male at Alve from early autumn - head and breast pattern 'diluted' with reduced bib, forehead white and white feathers scattered in hind crown, napa and mantle central and outermost tail feather pure white. Other sparrows do not seam to respond to it in any special way.	(CJH)

SYSTEMATIC LIST 1975

GREAT CRESTED GREBE:	C, 3 pairs at Gartmorn Dam.	(DMB)
LITTLE GREBE:	S, Airthrey Loch, 4.on 1st January, main arrival on 11th March.	(GS)
FULMAR:	S, 1 at Kincardine Bridge on 25th May.	(DMB)
CORMORANT:	C, South Alloa Bridge, 135 on 23rd March and 120 on 8th November.	(GS) (CJH)
	S, 687 on Upper Forth, 9th February.	(DMB)
SHAG:	S, 1 at Kincardine Bridge on 23rd March.	(DMB)

MALLARD:	C,	505 at Tullibody Inch on 2nd March.	(DMB)
	S,	max. 207 Airthrey Loch on 20th Janulary, 54% males.	(GS)
TEAL:	C,	Tullibody Inch, 449 on 23rd March. IGS)	
	S,	1 at Airthrey Loch on 28th October and 18th November. First record for the loch submitted to local recorder.	(DMB)
GADWALL:	C,	Marchglen, pr. on 19th-27th April.	(DMB)
	S,	2 at Kincardine Bridge on 2nd March.	(DMB)
		2 at Grangemouth on 24th August and	(DRW)
		2 on 12th October	(DT)
WIGEON:	C,	28 at Black Devon mouth on 23rd March.	(DMB)
		215 at Gartmorn Dam on 2nd January.	(DMB)
PINTAIL:	C,	50 at Tullibody Inch on 9th March.	IGS)
	S,	70 at Skinflats on 13th January.	(DMB)
SHOVELER:	S,	few records, max.9 at Grangemouth on 10th August.	(DMB)
SCAUP: GS)	S,	1 at Grangemouth from 13th-17th January.	(DMB,
TUFTED DUCK:	C,	4 adults on R. Devon at Alva 5th July.	(CJH)
		400 Gartmorn Dam 2nd January.	(DMB)
	S,	Airthrey Loch held about 5 prs., with well grown broods of 2 and 3 on 19th August.	(CJH)
		282 at Airthrey on 20th January.	IGS)
POCHARD:	C,	140 at Gartmorn Dam on 2nd January.	(DMB)
	S,	12 at Airthrey Loch on 1st, 2nd and 6th February.	(GS)
		10 males at Stirling Bridge on 3rd and 4th December.	(GS)

GOLDEN EYE:	C,	124 on Forth (Alloa), 2nd March.	(GS)
		70 at Gartmorn Dam on 26th December.	(DMB)
RED-BREASTED MERGANSER:	S,	the upper Forth held 285 in February and 270 on 8th November	(DMB)
GOOSANDER:	C,	15 at Cambus on 27th April.	(DMB)
	S,	14 at Stirling Bridge on 14th January.	(GS)
SHELDUCK:	C,	127 at Tullibody Inch on 12th October.	(GS)
	S,	Grangemouth. 2;071 on 12th January.	(DMB)
		c. 15 moulting adults seen 10th August.	(DMB)
PINK-FOOTED GOOSE:	C,	140 flew to W. Alva. on 26th April.	(CJH)
		100 flew to W. Alva. on 3rd May.	(CJH)
		Party heard flying E. Alva on 18th October.	(CJH)
	S,	100 in from NW. turned E. Airthrey 13th October.	(CJH)
MUTE SWAN:	C,	35 at Cambus on 9th February.	(GS)
	S,	40 at Cornton on 24th October.	(GS)
WHOOPER SWAN:	C,	50 at Menstrie on 26th January.	(DMB)
		42 at South Alloa on 18th February.	(DT)
		1 summered on Tullibody Inch.	(GS)
		In autumn there was no sign of usual large flocks feeding on farmland in Devon Valley. max. 20 at South Alloa on 8th November.	(CJH)
GOLDEN EAGLE:	C,	1 imm. Craig Leith on 11th October being mobbed by 15 crows.	(CJH)
BUZZARD.	Most records in autumn.		

SPARROWHAWK:	C,	4 Muckhart-Menstrie between 11th and 19th November.	(DMB)
	S,	5 near Kippen on 1st November.	(DT)
GOSHAWK:	S,	near Stirling on 12th October a raptor was seen flapping and circling at c. 3/4 mile range with x8 and x20 binoculars. Size estimated as large female Peregrine, but with Sparrowhawk shape except wings long as well as broad end rounded and wing stroke slower, more powerful and flexible then Sparrowhawk.	(CJH)
HEN HARRIER:	C,	a ringtail at Gartmorn on 14th September.	(CJH)
	S,	a ringtail at Denny on 19th	(CJH)
		October end November ringtail at Kippen on 1st November.	(DT)
PEREGRINE:	C,	1 at Blackdevon Mouth on 12th January end	(GS)
		1 at Dollar on 19th April	(DMB)
		Ochils, several reports early spring also singles 18th May, 29th June, 11th October and 8th November.	(CJH)
MERLIN:	S,	1 between Grangemouth and Skinflats. 12th January to 9th February, 10th August to 14th December.	(DMB, GS,DT)
KESTREL:	C,	max. 6 at Craig Leith on 25th August.	(CJH)
PARTRIDGE:	C,	frequent on S. slopes of Ochils, max. 9 on 29th November.	(CJH)
		40 in one field at Alloa on 8th November.	(CJH)
COOT:	S,	max. 144 at Airthrey Loch on 1st January.	(CJH)
OYSTERCATCHER:	First Inland records in spring were:-		
	C,	1 between Alva and Tillicoultry on 3rd February.	(DMB)
	S,	1 at Airthrey on 6th February.	(GS)

LAPWING:	C,	max. 1,300 at Menstrie on 12th October.	(CJH)
		2,800 at Tullibody Inch on 12th October.	(GS)
		Sheriffmuir. 1st post-breeding congregation of 23.	(DRW)
	S,	movement after snow: 30 to W. at Airthrey on 22nd January.	(CJH)
RINGED PLOVER:	S,	250 on upper Forth on 7th September.	(DMB)
GOLDEN PLOVER:	S,	882 on upper Forth during January.	(DMB)
		480 at Skinflats on 6th September.	(DT)
GREY PLOVER:	S,	145 on upper Forth on 2nd October.	(DMB)
WOODCOCK:	S,	Bridge of Allan, roding 10th March.	(GS)
		Airthrey roding 23rd February.	(DRW)
CURLEW:	S,	882 on upper Forth during January.	(DMB)
BLACK-TAILED GODWIT:	S,	up to 6 at Skinflats in January.	(DMB) DRW)
		2 in September.	(DT)
BAR-TAILED GODWIT:	S,	540 on upper -Forth on 7th September.	(DMB)
WOOD SANDPIPER:	S,	1 at Grangemouth on 10th August.	(DMB)
COMMON SANDPIPER:	S,	1st for summer at Bridge of Allan on 5th May:	(GS)
REDSHANK:	S,	1st inland for year. 9 at Stirling Bridge on 5th March.	(GS)
SPOTTED REDSHANK:	S,	1 at Skinflats on 23rd August.	(DT)
		1 at Grangemouth on 23rd August.	(DT)
GREENSHANK:	C,	1 at Black Devonmouth on 27th April.	(DMB)
	S,	Grangemouth 10th August - 2nd	(DT)
		October. max. 12 on 23rd August.	(DMB)

KNOT:	S,	7,160 upper Forth in January.	(DMB)
LITTLE STINT:	C,	1 at Kennetpens on 27th July.	(GS)
	S,	18 at E. Grangemouth on 7th September,	(DMB)
		1 at Grangemouth on 14th September.	(DT)
CURLEW SANDPIPER:	S,	3 at Skinflats on 23rd August.	(DT)
		2 at Skinflats on 6th September.	(DRW)
		5 at Grangemouth on 23rd August,	
		15 on 6th September, 1 on 14th September	(DT)
		1 on 10th August, 43 on	
		September 7th, 5 on October 2nd	(DMB)
		6 at Grangemouth on 6th September	
		and 30 at Grangemouth on 30th September.	(DRW)
DUNLIN:	S,	8,280 on upper Forth in January.	(DMB)
RUFF:	S,	4 at Grangemouth on 10th August,	
		4 on 7th September.	(DMB)
		1 on 6th September.	(DT)
		Skinflats, 9 on 23rd August, 1 on	
		6th and 14th September.	(DT)
TURNSTONE:	S,	172 on upper Forth in February.	(DMB)
ARCTIC SKUA:	S,	1 at Skinflats on 6th August, 18th	
		August, 5 flew high to W.	(DRW)
		1 at Skinflats on 6th September,	(DRW)
		and 2 at East Grangemouth on 6th September.	
GREATSKUA:	S,	1 at Grangemouth on 19th September.	(DRW)
LESSER BLACK-BACKED GULL:	C,	1 at Tullibody Inch on 16th November.	(GS)
	S,	2 at Stirling on 25th February.	(DMB)
LITTLE GULL:	S,	1 at Bo'ness on 21st January.	(GS)
		1 at Grangemouth on 20th July (imm.)	(DMB)
COMMON TERN:	C,	light passage to W. up river, at Alloa	
		on 14th September.	(TDHM)
	S,	Grangemouth, c.50 prs. in May	
		and 15 young seen in July.	(TDH, DRW)

SANDWICH TERN: C, light passage, W. up river, at Alloa on 14th September. ITDHM)

S, 20 at Grangemouth on 10th August. (DMB)

LITTLE TERN: S, at Grangemouth 6 on 20th July 10MB) and 2 on 6th September. (DT)

STOCK DOVE: S, 30 to SW at Airthrey on 8th November, (DMB) also 5 on 20th November and 2 on 2nd November.

WOODPIGEON: S, Denny (Barr Wood). Parties totalling 300 to SE in morning of 19th October. presumably a roost feeding movement. (CJH)

COLLARED DOVE: C, now well established Tillicoultry, several calling 15th March. (CJH)

CUCKOO: S, 1st of summer at Sheriffmuir on 30th April. (GS)

BARN OWL: C, some records Menstrie-Tillicoultry. (CJH, DMB, GS)

S, several records between Airthrey and Blairlogie.

KINGFISHER: C, 1 at Black Devon on 9th November. (AM)

S, 1 near Bridge of Allan on 2nd August, and 22nd October. Female caught. (CJH, (GS)

SWIFT: C, 1 at 01.00 on 25th July at Alva, against moon, at a height of less than 1,000 ft. (CJH)

S, 1 st of summer at Airthrey on 1st May, (DMB) with last at Bridge of Allan on 22nd August. (GS)

GREEN WOODPECKER: C, many records along southern fringe of Ochils; records outside of Ochils include several at Brucefield on 1st March. and 1 at Devilla Forest on 9th March.(CJH)

GREAT SPOTTED WOODPECKER:	S,	pr. bred Bridge of Allan, only summer record.	(GS)
SWALLOW:	S,	1st of summer at Bridge of Allan on 17th April.	(GS)
SANDMARTIN:	S,	1st of summer at Bridge of Allan on 20th April.	(GS)
RAVEN:	C,	pr. rebuilt nest on Craig Leith but no young seen.	(CJH)
JACKDAW:	C,	continues to be common in Hillfoots towns.	
	S,	650 at Sheriffmuir on 16th January.	(GS)
MAGPIE:	C,	max. 15 at Alva on 18th March.	(CJH)
		2 at Dollar all year.	(DMB)
LONG-TAILED TIT:	C,	max. c. 20 at Gartmorn on 14th September.	(CJH)
DIPPER:	C,	singing by tidal Black Devonmouth 9th November.	(GS)
FIELDFARE:	C,	spring, 500 at Devilla Forest on 9th March, strictly, W. Fife.	(CJH)
		1,500 nr. Clackmannan on 25th October.	(CJH)
	S,	20 to W. at Airthrey on 10th October.	(CJH)
		In winter, more than usual, e.g. 300 at Menstrie on 24th December.	(CJH)
REDWING:	C,	1st of autumn, 200 at Cambus on 12th October.	(GS)
WHEATEAR:	S,	1st of summer, male at N. Third Reservoir 13th April.	(AM)
STONECHAT:	C,	5 records 15-22nd March on gorse slopes above Alva and female with 4 juveniles seen 20th July, but no proof of local nest.	(CJH)
		1 Dollar mid-December.	(SBN)
	S,	Sheriffmuir, 5 prs. bred, arrived 1st week March.	(GS)
		Few winter records, 1 Fintry Hills 2nd February.	(GS)

SEDGE WARBLER:	C,	frequent by Devon at Alva 5th July. (CJH) 5 prs. at Cambus and 3 prs. at Kennetpans on 25th May. (GS) 6 at Cambus on 14th September. (GS)
BLACKCAP:	S,	Males at Logie and Larbert 18th January. (GS,JW) 1 at Stirling on 2nd February. (KA)
MEADOW PIPIT:	S,	70 on lawns at Airthrey on 8th April at a time when snow was on the Ochils. (CJH)
PIEDIWHITE WAGTAIL:	C,	4 M.a. alba at Black Devon mouth on 27th April. (DMB)
	S,	35 at Airthrey on 14th September. (CJH)
YELLOW WAGTAIL:	S,	Grangemouth, male 11th May, 2 prs. 20th July, pr + 2 juveniles 7th September 2 aduits feeding young (DMB) 19th and 21st July. (TDHM) DRW) Airthrey. 1 female on 1st June. (DRW)
WAXWING:	C,	30 on hawthorns. Gartmorn 9th January. (AM) 12 Kennetpans 23rd February. (DMB) Heard at Sheardale Wood on 23rd November. (TDHM)
	S,	7 at Airthrey on 25th November, ate haws, rowan, cotoneaster. Up to 21 on 27th November. (CJH)
GOLDFINCH:	C,	7 at 700 feet on Wood Hill on 18th January, feeding on burdock. (CJH)
	S,	5 at Airthrey on 20th January. feeding on burdock, also present May-June at Airthrey. (CJH)
SISKIN:	S,	male in small conifers at Pendreich on 21st (AM) June. 280 at Bridge of Allan on 21st December In birches.(GS)
TWITE:	S,	50 at Gargunnock Hill on 12th October. (CJH)
BULLFINCH:	S,	32 at Sheriffmuir on 23rd February, at 1000feet on edge of half-grown spruce plantation. (CJH)

SNOW BUNTING	S,	2 on carse stubble at Blairlogie on 12th January.	(CJH)
		110 at Skinflats on 12th January.	(DRW)
		7 on 13th January and 8 on 9th March and 20 at Grangemouth on 17th January.	(DMB)

The following species also occur regularly in the area but no notes of any interest were received in 1974 or 1975:

Moorhen, Herring Gull, Garden Warbler, Goldcrest, Spotted Flycatcher, Rock Pipit, Corn Bunting, Yellowhammer, Tree Sparrow.

Recorders:

K. Anderson, D. M. Bryant, C. J. Henty. A. Mitchell, T.D.H. Merrie, G. Shaw, P. W. Sandeman, F. Thorogood. R. Thomis, D. R. Waugh.

THE GOLDEN EAGLE *Aquila chrysaetos* IN THE WEST OF SCOTLAND

T.D.H. Merrie

INTRODUCTION

This study of the Golden Eagle *Aqui/a chrysaetos* was undertaken at the same time as several other similar studies elsewhere in Scotland. All these studies were co-ordinated by the Royal Society for the Protection of Birds and were aimed at monitoring the breeding success of local eagle populations following reports of reduced success associated with the use of organochlorine pesticides. The observations which form the basis of the analyses reported here, were made during the years 1963 to 1971 inclusive. However a yearly study over the same area has continued to the present date, undertaken by A. Gordon and M. Gregory. Lockie, Ratcliffe and Balharry (1969), and Everett (1971) have described the background and history of the nationwide survey, especially how a drastic reduction of breeding success had been noted in some eagle populations in the west of Scotland, while those in the east were relatively unaffected. This decline was linked with the use of organo-chlorines in sheep dips and when these organo-chlorine components were generally replaced by less toxic compounds, the breeding success of the affected eagle populations returned to more or less the former levels. In the study area known as South Argyll, however, the breeding success only partially recovered, and with a view to understanding the reasons for this I have undertaken a more detailed analysis of the South Argyll observations than has been done previously. To do this I introduced a factor that had not before been considered in the published literature available to me, namely the accessibility of nesting sites to humans and the consequent potential for disturbance adversely affecting breeding success. The importance of this factor was suggested because, in the South Argyll study area, the average breeding success of eagles in the less accessible mountainous terrain was consistently higher than that of eagles in the moorland terrain.

THE STUDY AREA

The study area of South Argyll is largely composed of terrain, which may be described briefly as mountain and moorland. The total area of this region is 3617 sq. km and contains 33 +/- 2 eagle territories, not all of which are occupied in any one year.

The mountain terrain contains well defined peaks ranging between 610 m (2,000 ft) and 975 m (3,200 ft) and steep sided valleys, often with large expanses of rock and broken cliff. Red Deer *Cervus elephus* are moderately plentiful and sheep common, though less numerous than in the moorland terrain. Ptarmigan *Lagopus mutus* occur in small numbers on all tops over 730 m (2,400 ft) high. Red Grouse *Lagopus lagopus* and hares *Lepus spp.* are not plentiful. The total area of mountain terrain is 1,312 km^2 and there are 14 territories.

The moorland terrain is uneven, ridged or undulating country with scattered small cliffs or ravines, and dotted with hill lochs. The average height is about 305 m (1,000 ft) with summits up to 610 m (2,000 ft). Sheep farming was then the most common land use though many parts were subjected to conifer afforestation, but considerable expanses, probably over 60% of the hill area, have by now been planted for forestry. Blackcock *Lyrurus tetrix* are increasing as a result, but numbers are still small. Red Grouse and hares are not plentiful but Rabbits *Oryctolagus cuniculus* are locally numerous. The Hooded Crow *Corvus corona* is comparatively numerous and several birds of prey are well distributed, in particular Hen Harrier, *Circus cyaneus* Buzzard *Buteo buteo* and Kestrel *Falco tinnunculus*. The total area of the moorland terrain is 2,305 km^2 and there are 19 territories.

METHODS

Field work techniques

The first year, 1963, was mainly exploratory and relied heavily on previous work by C.E. Palmar (1946-1958, unpublished), for the location and identification of pairs. Detailed observations began in 1964. Knowledge of the area increased year by year, until in 1971, 29 pairs out of the suspected 33 had been located.

All observations were made in free time at weekends or occasionally during the evenings. Consequently complete coverage of all suitable country was not possible in any year. In every year there were one or two territories to which our visits failed to give a definite indication of breeding status. Visits were kept to a minimum to avoid both undue disturbance and local interest, but were usually at least two per season per pair; one early on to assess whether laying had taken place and another to check on the presence or absence of well grown young.

In the early part of the season when disturbance could have been prejudicial to success, observations of all likely sites were made from a distance of 0.5 — 1 km using binoculars and telescopes. It is considered unlikely that any occupied nest was missed on areas of hillside scanned by this method. A sitting bird was always taken as evidence of laying. Unoccupied nests were examined for condition or contents, as long as there was not an occupied nest nearby.

Nearly all records of fledged young are from our own observations of young birds on the wing, or in the nest at an age when subsequent death before fledging would be unlikely (Brown 1969). The exceptions are observations by other persons whom we have found to be reliable. Two cases however did occur of a chick reaching the age when fledging seemed assured, only to die later. In both these cases deliberate human interference was suspected.

Analysis

Analysis was carried out to determine (a) breeding success in both types of terrain year by year, (b) proportion of non-breeding pairs, (c) influence of various circumstances, relating to nest sites, on success, (d) frequency of retention of nest site in relation to success and failure. Only the first two analyses are discussed in this paper. The last two will be presented in a second paper to be contained in the next issue of this journal.

From the analysis, tables 1, 2 and 3 were prepared, using the following definitions of breeding status - Occupied territory = An area associated with a nest site or sites not necessarily used, but in which eagles were regularly seen.

TABLE 1

The breeding status of Golden Eagle in the South Argyll Study Area ('Dieldrin period' 1964-1966: 'Post-Dieldrin period 1967-1971)

	Year	Total Occupied Territories	Total Recorded Breeding Pairs	Total Young Reared	Young per occupied Territory	Young per breeding pair
Both Terrains Combined	1964	12	7	4	0.33	0.57
	1965	11	8	2	0.18	0.25
	1966	12	10	4	0.33	0.40
	1967	12	8	6	0.50	0.75
	1968	13	9	6	0.46	0.67
	1969	15	12	8	0.53	0.67
	1970	16	14	10	0.63	0.71
	1971	23	16	14	0.61	0.68
Mountain Terrain only	1964	2	1	1	0.50	1.00
	1965	4	3	1	0.25	0.33
	1966	3	3	2	0.67	0.67
	1967	6	4	3	0.50	0.75
	1968	5	4	3	0.60	0.75
	1969	7	7	6	0.86	0.86
	1970	6	5	5	0.83	1.00
	1971	9	7	7	0.78	1.00
Moorland terrain only	1964	10	6	3	0.30	0.50
	1965	7	5	1	0.14	0.20
	1966	9	7	2	0.22	0.29
	1967	6	4	3	0.50	0.75
	1968	8	5	3	0.38	0.60
	1969	8	5	2	0.25	0.40
	1970	10	9	5	0.50	0.56
	1971	14	9	7	0.50	0.78

Proved Breeding Pair – where a female was observed sitting on a nest, or eggs or where young were seen.

TABLE 2 Golden Eagle breeding statistics in South Argyll

A comparison between the dieldrin period (1964-1966)
And the post-dieldrin period (1967-1971)

	Dieldrin years 1964-1966		Post-Dieldrin years 1967-1971		1964-1968 Deeside Figures for Comparison
	Mountain	Moorland	Mountain	Moorland	
Territories occupied Territories known	0.69	0.84	0.80	0.81	---
Pairs breeding Territories occupied	0.78	0.69	0.82	0.70	0.72
Pairs losing eggs in dutches Pairs breeding	0.43	0.67	0.22	0.38	---
Pairs rearing young Pairs breeding	0.57	0.33	0.78	0.62	---
Young reared Occupied territories	0.44	0.23	0.73	0.44	0.62
Young reared Breeding pairs	0.57	0.33	0.89	0.62	0.83
Young reared Successful pairs	1.00	1.00	1.12	1.00	1.31

Known territory – An area associated with a distinct group of nests, old or in use, which according to the normal spatial distribution of eagles cannot, or is very unlikely, to belong to a known adjacent territory.

Comparisons were made with results from Deeside 1964-68 which has been shown to have been unaffected by dieldrin, due to the very low number of sheep in that area (Everett, 1971)

TABLE 3

Golden Eagle breeding statistics in South Argyll
Total pairs breeding in relation to pairs occupying territory
(1964-1971 inclusive)

	A	B	C	Ratio Col.B Col. A	Ratio Col.C Col. A
Mountain terrain	42	38	34	.91	.81
Moorland terrain	72	65	50	.90	.69

Column A - Total occupied territories
Column B - Number of pairs sitting or with eggs + number of pairs paying attention to particular nest site.
Column C - Number of pairs sitting or with eggs, only.

RESULTS

Pair density

Of the total area, 1312 km^2, of the mountain terrain, 996 km^2 is suitable hunting ground. This gives 71 km^2 per territory. In contrast 1641 km^2 out of the total moorland area is suitable hunting ground giving 86 km^2 per territory. Ground considered unsuitable for hunting includes towns and villages, farmland and dense forestry plantations.

Breeding success

Table 1 presents the results of analysis on breeding success. The results in the first section, with both terrains combined, are similar to previously published information for the South Argyll area (Everett 1971). The differences are due to more accurate information coming to light after the annual reports had been submitted to the R.S.P.B.

When the two terrains are considered separately however it is seen that there is a marked difference in success between the mountain and moorland terrains, that in the mountain terrain being consistently higher even in the dieldrin years.

Occupation of territories and production of young:

The information from which Table 1 was produced is further considered in Table 2, to emphasise the differences between mountain and moorland. Figures from the Deeside area, also mountain terrain, but in the east of Scotland, are introduced for comparison.

Number of breeding pairs:

In Table 3 the collected data are reassembled to show that although the proportion of pairs which showed some indication of breeding behaviour in both terrains is the same, the proportion which persevered to the laying stage is lower in the moorland terrain than in the mountain.

DISCUSSION

Pair density:

It is stated above that the hunting area per territory is 71 km^2 in the mountain terrain and 86 km^2 in the moorland. These figures Indicate a much lower density than that given by Brown (1969) for an area in Sutherland. Brown's survey indicated an average area of 49 km^2 (12000 acres) for the hunting ground of each pair. This compares well with the density in a nearby island terrain in Argyll where about 10 pairs share a hunting ground of 390 km^2 giving an average of 39 km^2 per pair. The 'island' and Sutherland terrains are similar in having a very low human population, a large deer population, an abundance of suitable cliffs for breeding and large expanses of bare rocky landscape.

The availability of food in summer, is probably greater in South Argyll than in either Sutherland or the island terrain, due to the high stocking of sheep. However much of this summer sheep population is removed in the autumn, either to the sales or to lowland pastures, whereas in deer country the population remains and is only slowly eroded by shooting or natural

death. Shooting often increases the availability of carrion by reason of the discarded grallochs. The population densities are therefore probably determined by the available winter food supply, which is much greater in deer than in sheep country.

Production of young:

Previous work by Everett (1971) and others has shown that during the early 1960's eagles suffered a drastic decline in breeding success attributable to the use of dieldrin in sheep dips. Table 1 shows that the annual production of young per pair during 1967 to 1971 was consistently of a higher order than that during 1964 to 1966. Lockie et al (1969) found that the organochlorine residue levels in eggs taken from South Argyll (admittedly only 3) in 1966 were all of the same order as those collected during 1963 to 1965, when the low production of young was shown to be attributable to dieldrin intake. Accordingly the periods 1964 to 1966 and 1967 to 1971 are considered separately in the following text and are referred to as the dieldrin' and 'post-dieldrin' periods respectively.

During the dieldrin period, average annual production of young in the mountain terrain was 0.44 per occupied territory and 0.57 per breeding pair. This was about twice that in the moorland terrain which was 0.21 per occupied territory and 0.33 per breeding pair. During the 1950's production had averaged about 0.8 young per breeding pair over the whole area (C.E. Palmar in litt.), which is of the same order as that of Deeside during 1964 to 1968. For the purpose of this discussion it is useful to take the figures for Deeside over the period 1945 to 1968 as typical for an area with an adequate food supply and relative freedom from toxic chemicals and disturbance (Watson 1957, 1969 and Everett 1971). After the widespread use of dieldrin ceased in about 1966, recovery was noted in both types of terrain. The production in the mountain terrain recovered to its former level and thus on average 0.73 young per occupied territory and 0.89 per breeding pair were recorded. This is slightly higher than that of Deeside (0.62 and 0.83 respectively), indicating a return to the normal level of success.

In the moorland terrain however the recovery was only partial, averaging 0.43 young per occupied territory and 0.63 young per breeding pair. It should also be noted that the ratio of breeding pairs to occupied territories is lower in the moorland terrain than in the than in the mountain terrain in both dieldrin and post –dieldrin periods.

Population replenishment.

The average production of young per successful nest is higher in Deeside 1964 to 1968, than in either the mountain or moorland terrain (Table 2). Two young per nest is quite common on Deeside but much less frequent in the mountain terrain and did not occur in the moorland terrain during the period of the study. Brown and Watson (1964) demonstrate the much greater food supply of Deeside compared to the West of Scotland and this surely contributed to the larger brood size of productive nests in Deeside. However the proportion of pairs occupying territory which are proved to breed, is higher in the mountain terrain (0.82) than in Deeside (0.72), with the result that the annual production of young per occupied territory was actually greater in the mountain territory (0.73) than in Deeside (0.62). It may be taken therefore that the rate of production of young, without any unnatural external influence, would be between 0.73 and 0.62 young per occupied territory and it seems likely that this level of breeding success is sufficient to maintain the breeding population and also to give rise to a surplus of young. This is surmised because during the 1939 to 1945 War eagles were able to breed free from disturbance and many haunts from which they had been driven by persecution were in consequence reoccupied.

During 1967 to 1971 the average production of young over the whole South Argyll area was 0.56 per occupied territory, with the figure of 0.73 in the mountain terrain being counterbalanced by 0.44 young per occupied territory in the moorland terrain. It would seem possible therefore that any excess production in the mountain terrain may have filled most of the vacancies in the study area, because the number of territories known to the observers during the survey has trebled in the mountain terrain, but has not increased greatly and has been erratic in the moorland terrain. Although this difference would be partly explained by more thorough exploration as the survey developed, it is considered more likely to be due in part to the infilling of unoccupied territory throughout the mountain terrain.

The low production in the moorland terrain, and the relatively slow build-up of occupied territories in the mountainous terrain, will be factors that are linked with a lack of further expansion of the Golden Eagle to other areas in southern Scotland. It is therefore of great interest to try and identify the reasons why success continued to be low in the moorland areas.

Number of breeding pairs.

Up to now a pair has been regarded as breeding only when there have been eggs in the nest or the female has been sitting. If however we take into account those pairs which have shown attention to a particular site, but have not apparently laid or been sitting then a different situation emerges.

From Table 3 it will be seen that the ratio of the number of pairs sitting or with eggs plus those paying attention to a site, to the number of occupied territories is the same for the mountain and moorland terrains.

However whereas 0.9 of pairs paying attention to a site laid eggs in the mountain terrain, only 0.8 of those in the moorland terrain did so. This could be explained in two ways. First there could be a higher proportion of immature eagles in the moorland population, resulting from a higher adult mortality, with vacancies being filled by overspill of immatures from the mountain population.

Second there is the possibility that failure to breed is also caused by factors similar to those leading to the low success of breeding pairs and that immaturity is not the only factor. The main differences between moorland and mountain considered to be important are the smaller cliffs and the higher human population of the moorland terrain. Human disturbance could therefore be greater in the moorland area and may be the main reason for the lower productivity of moorland eagles, and an attempt will be made in a subsequent paper to relate characteristics of sites and the associated disturbance, to breeding success of Golden Eagles.

SUMMARY

In 1964 a survey of Golden Eagles in several different parts of Scotland was initiated to monitor their breeding success in relation to the use of organo-chlorine pesticides in sheep dips. This survey has continued to the present date. This paper presents the results obtained in the South Argyll study area from 1964 to 1971. The methods of observation and of analysis of records are explained.

The South Argyll study area has been treated as a single unit in previous papers which have shown that eagles in this area did not recover fully, after the use of dieldrin in sheep dips ceased, as did eagles in other areas. However South Argyll may be split into two quite distinct types of terrain, mountain and moorland. Eagles in the mountain terrain are shown to have regained their former levels of breeding success, whereas those in the moorland terrain have not.

As well as exhibiting lower breeding success the moorland eagles also have a higher proportion of non-breeders. This could be due to a higher proportion of immature or inexperienced eagles associated with higher adult mortality, or to some other factor such as disturbance.

The questions posed by the results of this analysis prompted further research into the nature of nesting sites and the relation of breeding success, and the eagles' responses to failure or success. The results of this work will be discussed in a later paper.

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OUR 'DISAPPEARING' BUTTERFLIES

George Thomson

There is a general impression amongst the adult population in Scotland that there are fewer butterflies about today than in their youth. Many knowledgeable naturalists also believe that this is the case. Clearly, if recent industrial or housing development has destroyed the habitat of a species in the immediate vicinity of one's home, it could be expected that not so many butterflies would be noticed there. It will be shown in this paper, however, that the changes in the distribution of most of our species took place before the birth of many of the people who have suggested that our butterflies are 'disappearing' that is, more than seventy years ago, and when they did change their ranges, man was not instrumental to any significant extent.

The causes have been complex and almost certainly multifactoral, but if a single reason must be pinpointed we must look for natural causes and not to the effects induced by man. Thus the present concern for our fauna, while perfectly justified in the case of many of the higher mammals and birds, is hardly justified in the case of butterflies in Scotland. Reference is here being made to Scotland alone. South of the border the situation is quite different and is, quite rightly, being monitored by bodies such as Monks Wood Experimental Station in the form of the 'European Invertebrate Survey', so that the scale of disappearance can be assessed.

It is thanks to the dedication of the great Scottish naturalists of the last century that we have what is possibly an unequalled record of the distribution of our butterflies in the nineteenth century. Without doubt the most eminent was Dr. Francis Buchanan White (1842-1894) from Perth whose knowledge of Scottish lepidoptera was greater than any of his contemporaries. Through his contributions to the 'Scottish Naturalist' and those of collectors in other parts of Scotland to that journal, the Proceedings and Transactions of local natural history societies and to the entomological journals, supplemented by the records found in other literature and the collections housed in Scottish museums, it is possible to build up a fairly accurate picture of the distribution patterns of butterflies through Scotland from the beginning of the nineteenth century to the present day.

There have been, at one time or another, some fifty-seven species of butterfly recorded in Scotland. This number includes species which have proba-

bly been introduced accidentally, those which are probably errors (misidentifications and so on) and those which were certainly found but which are now extinct. The first two categories do not concern us here as none of the introductions has resulted in permanent populations. Those which have become extinct in Scotland have some considerable bearing on the problem of distribution change. If these species are added to those which are still to be found it can be said that the Scottish fauna has comprised forty-five species.

MIGRANT SPECIES

Of this number, eight species are migrants, and do not overwinter in Scotland: consequently, their apparent abundance is entirely dependent upon the numbers which reach the border and beyond. The actual numbers which arrive are difficult to estimate. They are also difficult to compare with the records from the last century because throughout Britain as a whole there are possibly more people reporting butterfly records to journals now than in earlier days, although in Scotland this might not be the case.

The Clouded Yellow *(Colias crocea* Geoffrey in Fourcroy) reaches south-west Scotland more often than not, but there are only about half a dozen reports of the species from central Scotland, from near Glasgow in the west to Fife and Perth in the east. As with its close relative, the Pale Clouded Yellow *(C. hyale* L.) for which there are three records, there is no evidence that it reached Scotland more frequently or penetrated further into Scotland last century than it does now. The same can be said for the much more common Red Admiral *(Vanessa atalanta* L.) and the Painted Lady *(V. cardui* L.) both of which reach central Scotland most years. The Camberwell Beauty *(Nymphalis antiopa* L.), however, was more frequently reported in the 1800's than in recent years. Indeed, judging from the number of specimens in Scottish collections, it can be assumed that this handsome butterfly arrived regularly and could be found in most of central, southern and eastern Scotland last century. The Monarch *(Danaus plexippus* L.) was not found in Scotland until 1941 and there is only a single record to the Queen of Spain Fritillary *(Issoria lathonia* L.) from Minto, Roxburghshire. Also the Long-tailed Blue *(Lampides boeticus* L.) has been seen only once, at Ardrossan, Ayrshire.

SPECIES WHOSE DISTRIBUTIONS HAVE CHANGED LITTLE

The distribution of about half of the remaining species has changed little since records began. Of the three 'whites' the Large White *(Pieris brassicae* L.) is possibly the least common in central Scotland, usually appearing in May or June although sometimes only one or two specimens are seen in late summer, if conditions have been unfavourable. The Small White *(P. rapae* L.) occasionally reaches pest proportions, but in the central area the Green-veined White *(P. napi* L.) in the form of a distinct sub-species (*thomsoni* Warren) outnumbers the others. The Green Hairstreak *(Callophrys rubi* L.) Small Copper *(Lycaena phlaeas* L.) and Common Blue *(Polyommatus icarus* Rott.) are found throughout the central belt more or less commonly, the former where blaeberry *(Vaccinium* sp.) abounds and the others frequently repopulating derelict land. The Small Tortoiseshell *(Aglias urticae* L.) is to be found everywhere, including the centres of our larger towns. One must look for wet meadow in order to find the Small Pearl-bordered Fritillary *(Clossiana selene* Denis and Schiff.) and moors to find the Dark-green Fritillary *(Mesoacidalia aglaia* L.). Both are to be found in central Scotland. There is a gap in the range of the Scotch Argus *(Erebia aethiops* Esp.) in central Scotland. There is an old record from the Trossachs and a doubtful one from Flanders Moss but the nearest localities now appear to be in north Perthshire. TN Mountain Ringlet *(E. epiphron* Knoch) does not descend below 300 m but above this level it can be found on Ben Lomond and might still be found on some or our other local hills at a suitable elevation. The Meadow Brown *(Maniola jurtina* L.) and Small Heath *(Coenonympha pamphilus* L.) are widespread and sometimes rather common on grasslands in central Scotland but the other 'Heath', the Large *(C. tullia* Muller), is restricted to peat bogs such as Letham Moss, Flanders Moss and Strathblane Moor.

The Chequered Skipper *(Carterocephalus palaemon* Pallas) was not found in Scotland until 1939 and the Holly Blue *(Celastrina argiolus* L.) was first recorded in 1950. The Peacock *(Inachis io* L.) has had an odd history being quite common over a number of years then almost disappearing for a time before returning to its previous abundance. It was extremely common in central Scotland in 1955. The Brimstone *(Gonepteryx rhamni* L.) has been known to migrate and the five records from Scotland might be the result of this or accidental introduction. It is curious that three of the reports, apparently all *bona fide* sightings, are from Fife, and a fourth is from Perth.

EXTINCT SPECIES

Eight species have, almost certainly, become extinct in recent times. The Large Tortoiseshell *(Nymphalis polychloros* L.) has never been a common species in Scotland. There are single records from Cairn Ryan, Ayrshire and Preston, Berwickshire in the late nineteenth century. Castle Sweyne (1901) and south Knapdale (1887). Buchanan White (1871) reported it as 'very rare' in the Tweed, Forth and Dee districts. The records from the Dee district are interesting as there are other records from this area including a few at Inverurie in 1872 as well as a remarkable report (Palmer, 1974) of the species being seen every year up till about 1960 from a locality south of Aberdeen. The Small Skipper (*Thymelicus sylvestris* Poda) was reported as being 'not rare' in the neighbourhood of Edinburgh before 1809 (Stewart, 1811), but there are no further records from there. This butterfly could well have been more widespread in the past but only just survived into the nineteenth century in Scotland. The Grizzled Skipper *(Pyrgus malvae* L.) was reported by Lennon (1862) at Glen Mills near Dumfries and by Buchanan White (1871b) at Inveran, Sutherland. The most recent records are those of Evans (1909) who reports it from 'heathy places near Glasgow' and Cairn Ryan in 1896.

The Silver-studded Blue *(Plebejus argus* L.) is another of the species for which there are few records. It was said to be found in the neighbourhood of Edinburgh in 1809 (Stewart *loc.cit)* and near Killiecrankie by D. P. Morrison *ante* 1871. There is a more recent report from near Gourock in 1895, the last, apart from an apochryphal account by Perry (1948). The Duke of Burgundy Fritillary *(Hamearis lucina* L.) must have disappeared earlier as there are only two records, one from Dalswinton (Lennon, 1862) and one from Denholm, Berwickshire in 1868. Denholm also boasts the last record of the Comma *(Polygonia c-album* L.) where it was said to be scarce in 1868, although it was possibly found in Fife about the same time. It was reported from Edinburgh in 1809 by Stewart *(loc.cit).*

There are odd records of the Silver-washed Fritillary *(Argynnis paphia* L.) which prevail until the end of the nineteenth century. These range from Edinburgh to Arrochar and from Bennachie to Muchalls. There are also records from Roxburghshire and Berwickshire. The Gatekeeper *(Pyronia tithonus* L.) was found in Kirkcudbrightshire, Ayrshire and even Wester Ross up to the

1860's and perhaps later 93 but certainly not beyond the end of the last century. It might seem odd, however, that there are no specimens of this species from Scotland in any of the old collections, and Ford (1945) expressed this sentiment. But neither are there specimens of most of these extinct species as far as we know. Few collectors at that time put data labels on their specimens so what might be missing is the data, not the specimens.

SPECIES WHOSE DISTRIBUTIONS HAVE CHANGED

The ranges of the remaining twelve species have contracted to a greater or lesser extent from the beginning of the last century and it is this group which demands close study. It is fortunate that the past record of the distribution of these butterflies is well documented and we can be fairly certain that the account of their ranges is, in general, accurate. Some of the less conspicuous species like the Dingy Skipper might well have been overlooked in the past, but there is every likelihood that the very same species are overlooked today.

The Large Skipper *(Ochlodes venata* Bremer and Gray) Map 1

This butterfly was never found north of the central belt and here the only records are from the neighbourhood of Edinburgh reported by Stewart in 1809 and, presumably the locality mentioned by Lowe and Logan (1852), the Botanical Gardens of that city, refers to the same colony. Stainton (1857) repeats what is probably the same report. It was not found much to the north of Dumfries in the west, but from there there are a number of records, mostly from coastal localities. William Shaw (1896) reported the species from Galashiels. The Edinburgh Colony must have disappeared before the middle of the nineteenth century as it ceased to appear in lists about that time. The Galashiels report was not confirmed by later collectors and, while this colony might still exist, it is more likely that this skipper is now restricted to the southern part of the Kirkcudbright — Galloway coast where it is still rather common.

Dingy Skipper *(Erynnis tages* L.) Map 2

As long ago as 1868 *tages* was reported as being a rare butterfly in Scotland. It would seem that the butterfly has always had two separate distribution areas in Scotland, one in the north-east, but extending into Ross-shire and the other in the south-west this probably being a continuation of its

colonies in England and Wales. There is little evidence to show that this north-eastern range has changed from the early days of collecting, but in the south-west the species was found as far north as Glasgow in the middle of the nineteenth century, although there was only a single known locality north of Ayr. Today its range reaches Girvan on the south-west coast.

Orange Tip *(Anthocharis cardamines* L.) Map 3

About 1850 this species must have had an almost continuous distribution from the borders to Glasgow in the west and to the Moray Firth in the east. It was not rare in the Edinburgh district in 1809 and remained in the Lothians until the 1860's. In the Clyde area before 1900 it had been found in Lanarkshire, Renfrew, Paisley, Gourock and also Ayrshire where it was said to be generally distributed and rather common. Buchanan White (1871 b) said that it was sometimes common in the Almond, Muirhall and Methven areas of Perthshire and also Glen Farg. It was found in Stirlingshire about the same time and in Berwickshire prior to 1880. By 1900 it had gone from the Glasgow area. In 1921 it was said to have been lost for several years in Glen Farg having been very scarce in the 1881 — 6 period. As early as 1852 it was reported as being local and rather scarce at Duddingston, Musselburgh and Balgreen and must have disappeared shortly after that time. By 1900 it had become less common in the eastern borders and extinct at Gordon Moss, Berwickshire having contracted it range towards the south-west of the country and the lower valleys of the Spey, Dee and Don. About thirty years ago it began a very slow increase in its range appearing at Aviemore in 1954 and becoming much more common especially in the north-east. There is some indication that this spread is gathering momentum and there is even a single record from north-west Sutherland.

Small Blue *(Cupido minimus* Fuessly) Map 4

This is one of our most local species, its distribution being restricted by the presence or absence of its foodplant Kidney Vetch *(Anthyllis vulneraria).* However, while early records emphasise the small number of localities for the butterfly, there seems to have been no real shortage of places where this tiny species could be found, extending from Kerrara on the west (1860) to the Moray Firth on the east. It was found in Galloway, Arran and Ayrshire until the second half of the last century. In the border counties it was found in Roxburghshire in the 1880's, but in the Galasheils district it was rare by

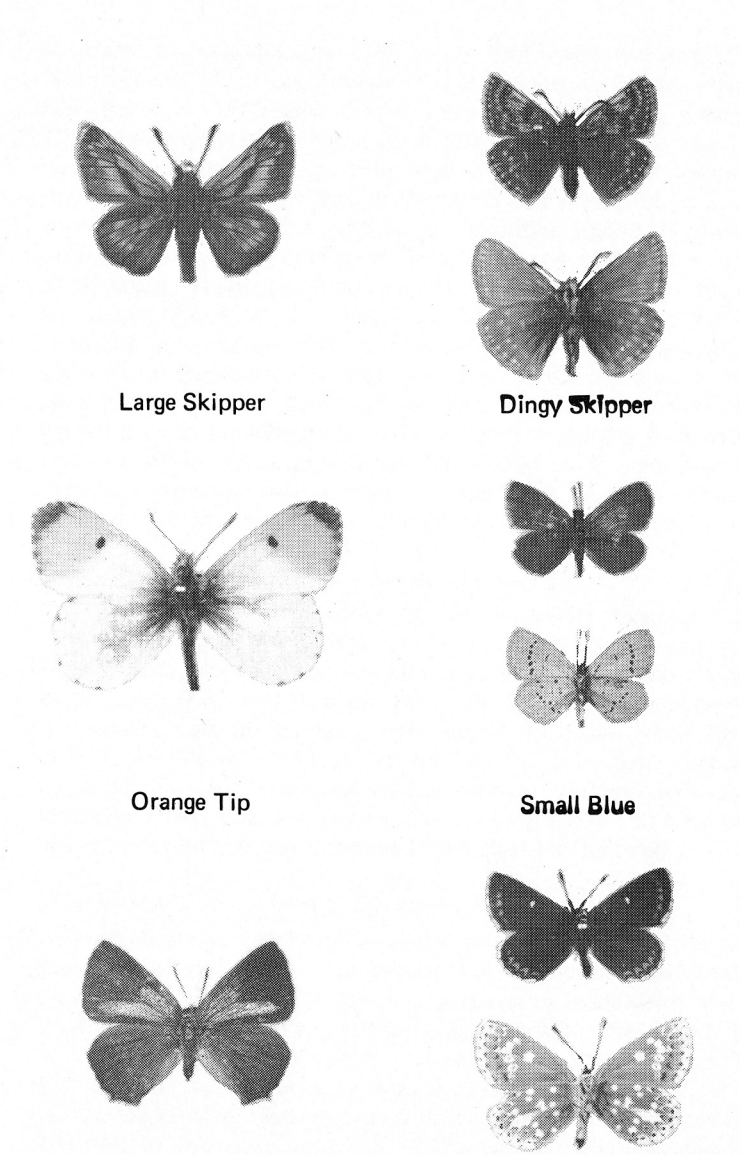


PLATE 1 Scottish Butterflies whose distributions have changed since records began.

1896. Lowe and Logan (1852) said that it was rare in Midlothian being reported first by Stewart (1811). Buchanan White collected it near Perth in 1870 and Ellison found it in the same localities in 1884. It penetrated as far west as Glen Lochay at this time. There were several localities in Fife and one of these, at Burntisland, survived until at least 1894. In the north east it was found in coastal districts as well as a couple of localities inland (Deeside and Strathspey). By early this century it could not be found in the west of Scotland. There is a recent report from Galloway, but the record is suspect. None of the inland localities in the border region was thought to produce this species beyond 1900, although it has survived on the south-east coast. However, in the last year or so three separate reports have been received, one from Roxburghshire and the others from Kirkcudbrightshire. It has gone from the Fife and Perth districts, while it has maintained its ground in the north-west, if a little less common than formerly. It has been found in Wick in the last few years where it might have been overlooked before.

Purple Hairstreak *(Quercusia quercus* L.) Map 5

The inconspicuous appearance of this butterfly together with its "tree-top" frequenting habits probably accounts for the paucity of records both from last century and in recent years. It was found near Perth until 1881 and perhaps later, but the only other report from the eastern part of Scotland was that of Buchanan White from the district of 'Forth' (1871 a). It has hardly ever been reported as common, but before the end of last century it disappeared from the localities in the east and during this century appears to have become less common in the few localities in which it has survived.

Scotch Brown Argus *(Aricia artaxerxes* Fabricius) Map 6

Arthur's Seat in Edinburgh was the place from which the original specimen of this species was taken. It is said to have survived there until 1869 (Evans, 1909). There is, however, a specimen in the Royal Scottish Museum marked 'Arthur's Seat 1898'). The Scotch Brown Argus was amongst the species which English collectors coming to Scotland in the last century would expect to find easily. It had a fairly extensive distribution through the south of Scotland to Ayrshire in the west until the 1890's and through east and central Scotland, including Fife, the Perth district and Glen Lochay, about the same time. In 1845 it was reported from Dumyat and was said to be not uncommon in 1852 in the Ochil Hills around Menstrie and Logie. Further north its

range reached the Caledonian Canal, Aberdeenshire and Banffshire. There is even a report of the butterfly in Shetland, but the accuracy of this report is doubtful. Between 1860 and 1900 *artaxerxes* disappeared from its localities in the Lothians and central Scotland. It has survived in at least two localities in Fife but has disappeared from the Perth district. Further north it became less common except in north-east Perthshire. However, it has been found in two places north of the Caledonian Canal in recent years. The status of the more northern localities in south-east and south-west Scotland appears to have become more precarious.

Pearl-bordered Fritillary *(Clossiana euphrosyne* L.) Map 7

Some reports from the middle of last century suggest that this butterfly was, at times, more common than its very similar relative *selene,* but it is doubtful if this was ever really the case. There is little doubt that this species had a fairly continuous, if sometimes sparse, distribution throughout the country at least as far north as Ross-shire. It was always less common in central and southern Scotland than in the Spey district and the west, being reported even from Rhum in 1938 by Professor Heslop-Harrison. In central Scotland there are records from Edinburgh (1809) and various sites in Perthshire. Some of the latter localities still survive like that at Crieff and Aberfoyle, but others no longer produce the butterfly, or it may still be rediscovered. These are Glen Lochay *(ante* 1900), Glen Farg (1880's), Scone and Birnam (about 1870). There is an old report from Bridge of Allan where it was found by Buchanan White in the 1860's, but repeated searches have not confirmed its existence there in recent times. Further south the butterfly must have disappeared from Ayrshire by the end of the last century. There is no doubt that the species is very much more local and rare now than before.

Marsh Fritillary *(Euphydryas aurinea* Rott.)

Map 8 According to Stainton (1857) the Marsh Fritillary was rare in Scotland. Reports in contemporary journals do not substantiate this account, but the butterfly was restricted to three main areas, the west coast and Inner Hebrides from Islay to just north of the Caledonian Canal, from the Forth to Aberdeen in the east and the borders, particularly the eastern borders. While the western localities have maintained their ground, there remains only one locality on the other side of the country, that being in Aberdeenshire. It appears to have been common, although very local, in one or two places near

Perth in 1881 and shortly before that in the Trossachs and even Bridge of Allan. It hung on at Logiealmond until at least 1921, but there are no more recent records from there. In Dumfriesshire it was last seen in 1949.

Speckled Wood *(Pararge aegeria* L.) Map 9

An excellent account of the change in the distribution of this butterfly is given by Downes (1948) showing that the species was found from the borders to Aberdeen in the east and to Skye in the west, with a significant gap in its distribution in the Central Highlands to the Moray Firth. This distribution pattern appears to have been maintained until about the middle of the nineteenth century when the species disappeared from the Edinburgh district, followed in the 1860's by a decline in the Perth district and further north in the east, barely surviving the 1880's. It seemed to have remained as a rarity near Perth until as recently as 1921. On the west coast and in the Inner Hebrides the species held its ground being more or less common from year to year. In the 1960's the Speckled Wood appeared to be extending its range northwards and in 1969 was found for the first time in the Black Isle, later being found as far east on the Moray Firth as Lossiemouth. Unfortunately, all of the southern populations had disappeared by the early 1900's and, as yet, there is no sign of a return to its old haunts.

Wall *(Lasiommata megera* L.) Map 10

One of the most interesting changes in distribution over the last one hundred and fifty years can be seen in the Wall Butterfly. It must have been found almost everywhere as far north as Aberdeen in the east and Glasgow in the west. It is a species which is, as its popular name suggests, not fussy about its habitat being found as a roadside butterfly as well as in rough fields, waste ground and gardens. Probably not more than a hundred years ago the butterfly would be a common sight to most people in all but the most urban districts of central Scotland. It was reported as common in Fife and the west of Scotland in 1851 and a year later it was said to be not infrequent in the Lothians. The year 1860 saw a change in the situation. It became uncommon in the Perth district through the 1860's, and must have become extinct in that region by the early 1870's. A few years later it had become scarce further south, in both the east and the west, until it remained common only in the south of Galloway. However, the butterfly has been reported singly from districts beyond its present stronghold in Scotland. It was found

in 1955 in Berwickshire, for example, and there is a very recent report of the species in Islay.

Grayling *(Hipparchia semele L.)* Map 11

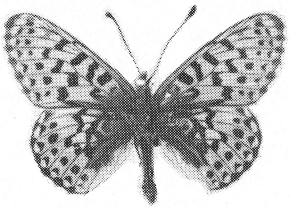
It has been said that one has little chance of seeing the Grayling unless you can also see the sea. While this is now the case in Scotland, with a few exceptions, the species has not always been coastal in its distribution. It appears to have been common near Perth in the second half of the nineteenth century and on Minto Crags, Roxburghshire, about the same time. There, and also in several places in the Hawick and Galasheils district, it was common until at least the end of the last century and probably for twenty years more. There is an old record from the western part of the Campsie Fells. Since 1900, the coastal localities too have diminished in number, but not significantly, while in some parts of the country there is some evidence of a move inland, the butterfly having been found on Ben Cruachan and also at Glengarnock in Ayrshire some fifteen miles inland.

Ringlet *(Aphantopus hyperanthus* L.) Map 12

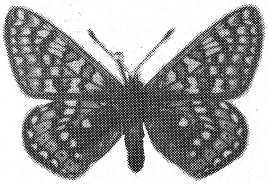
Compared to some of the previous species, the Ringlet's distribution has changed far less markedly. It has, however, disappeared from some of its more northern localities such as Skye (*ante* 1860), Glenshian and also from some of its old haunts near Edinburgh and Glasgow.

DISCUSSION

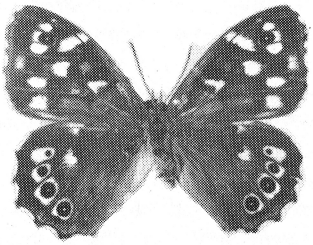
From this outline of past distributions it will be seen that two of our species ranges contracted before 1850 (Large and Dingy Skippers) six became less widespread sometime between 1850 and 1900 (Orange Tip, Small Blue, Scotch Brown Argus, Pearl-bordered Fritillary, Wall and Ringlet), while the remaining four have disappeared from former localities since the beginning of the present century. The first and most important observation which can be made from this is that there has not been a general decline in our butterflies within the lifetime of most of us. Indeed, the reverse may be the case. There is strong evidence that a number of our butterflies have become more common or more widespread in recent years. The Orange Tip appeared in Strathspey in the 1950's after a lapse of almost 100 years and is now a rela-



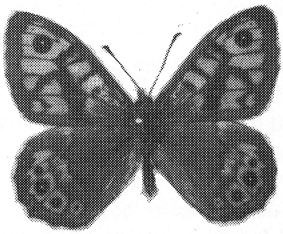
Pearl-bordered Fritillary



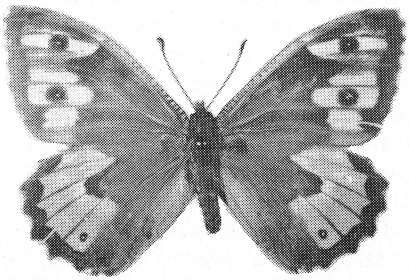
Marsh Fritillary



Speckled Wood



Wall



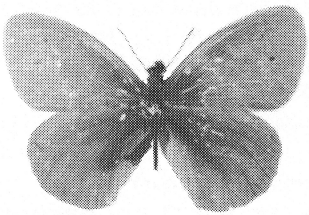


PLATE 2 Scottish Butterflies whose distributions have changed since records began.

tively common species from Newtonmore northwards. The Holly Blue has appeared in Dumfries (1950) having apparently spread from localities south of the border. The Small Pearl-bordered Fritillary is now more common than formerly in suitable locations throughout the country. The case of the Speckled Wood has already been cited and the Scotch Argus is also showing a similar spread eastwards.

The retraction of the species ranges within each of the date classes show a significant common trend. Of the butterflies in the 'pre 1850' and '1850 — 1900' groups there are three species which show an overall reduction in the number of localities in which the species are found (Small Blue, Pearl-bordered Fritillary and Ringlet), three which have become mainly restricted to the south-west and the north-east i.e. north Perthshire to the Moray Firth (Dingy Skipper, Orange Tip and Scotch Brown Argus) and two which have become restricted to the south-west (Large Skipper and Wall). On the other hand, three of the four species which have changed their distribution since 1900 (Purple Hairstreak, Marsh Fritillary and Speckled Wood) have retracted to the west of Scotland, a trend not observed in the other groups. Clearly, the effect of man on the situation over the past one hundred and fifty years must be negligable as he could not have brought about these clear patterns of distribution modification. Many human activities have been blamed for the reduction in butterflies including afforestation, insecticides and herbicides, over-collecting, ploughing and the destruction of permanent pasture, burning of heaths and grasslands and even golf. An examination in detail of each of these factors is beyond the scope of this paper, but mention may be made of the ones which are most usually blamed. The planting of extensive coniferous woodlands obviously affects the ecology of the land on which they grow; little by way of vegetation can survive below the canopy of a mature coniferous forest. But these woodlands are rarely planted on land of prime economic or entomological importance. The most likely species to be affected are the Small Pearl-bordered Fritillary and the Large Heath, but neither of these has shown a reduction in their numbers in Scotland, except in a few localities. On the contrary, an interesting and unexpected association appears to have developed between young plantations and some butterflies, notably the Pearl-bordered Fritillary and the Chequered Skipper, no doubt because of the protection afforded to the host plants in the early growth stages of the trees. The escalation in the use of synthetic organic insecticides did not occur until after 1845, much too late to cause the changes in distribution which have been described. The reproduc-

tive potential of insects, including our butterflies, is great and we can dismisss the suggestion that collecting has had any effect on our species with some confidence, but the destruction of permanent pasture appeals to be, at a first glance, a fair reason. However, once again changes in agricultural practice took place at a time which did not coincide with the changes we have seen in our butterflies. Similarly, the burning of heaths and grasslands had been practised for many years before the period which is being discussed. Even Gilbert White in his 'Natural History of Selbourne' (1788) expressed his concern:

> "...yet, in this forest, about March or April, according to tne dryness of the season, such vast heath-fires are lighted up, that they often get to a masterless head, and, catching the hedges, have sometimes been communicated to the underwoods, woods, and coppices, where great damage has ensued."

There have been, of course, local extinctions which are due to causes which are not entirely natural. The best documented of these is that of the Scotch Brown Argus on Arthur's Seat, Edinburgh. The account of Logan (in Stainton, 1857) was prophetic:

> "I have not diminished their numbers, having always a wholesome dread of exterminating species; but I believe a dealer has, and a host of small boys who come out of Edinburgh, with orange-coloured nets, and bottle them up wholesale, five or six together, alive, in the same receptacle, generally a matchbox, along with Blues and anything else they can find ..."
>
> In addition to all this, Government has agreed to construct a carriage-road between Edinburgh and Duddingston, much to my disgust, as it is to come along the line o' the present footpath, and will destroy all the best localities for *artaxerxes, obelisca* etc.

Twelve years later, the last specimen was taken in that locality! What is not so well known is that the species was also found on the nearby Salisbury Crag and must have become extinct about the same time. Therefore, we have a situation where it would appear that over-collecting combined with the building of a road has led to the extermination of a butterfly locality but doubt must now be thrown on this explanation when we know of the adja-

cent locality on Salisbury Crag which, without the highway or small boys with their orange coloured nets, lost *artaxerxes* at the same time.

There is an explanation for the changes which took place which also explains the nature of these changes. It is well known that the climate of Scotland became more oceanic in the middle of the last century. Indeed, throughout papers on Scottish lepidoptera published between 1860 and 1870 we can read of the disasterous summers of the decade having an effect on the species. Newman (1870) makes it quite clear with reference to the Wall in Scotland:

> "... the series of cold summers following that year (1860) seem to have destroyed the species.'"

We read the same comments in the case of *aegeria, minimus* and even some of the more common and widespread species, after which there was no mention of these butterflies regaining their former ground or returning to their former abundance, until very recently. Butterflies like *aurinea* and *quercus,* which tolerate, or perhaps even require, more moist conditions, became restricted to the western part of the country. Others, like *megera* and *venata* disappeared from all but the most favourable parts of the south-west, while the third group, in addition, kept their foothold in parts of the north-east.

One element in the nature of distribution changes has not yet been mentioned. Short term fluctuations in population numbers is the rule rather than the exception. The Meadow Brown, Small Copper and Marsh Fritillary butterflies show marked changes in their numbers as well as increases and decreases in the areas which they inhabit. Thus, in certain years, the Meadow Brown may be found some considerable distance from its main stronghold and could, for example, be found in gardens one year and not be noticed again for a decade. These periodic tendancies for a species to move out from its population centre come under the heading of dispersal. Laidlaw (1970) postulates that population fluctuations are due to sunspot activity, but this theory is hotly disputed by many zoologists. Dennis (1976) and Heath (1974) have shown that very subtle changes in climate can produce significant changes in a species range. Last summer (1975) was one of the best for many years. The numbers of butterflies and moths were greater than had been observed for some time and the migrant species penetrated well into Scotland. The Red Admiral and Painted Lady were moderately common in cen-

tral Scotland and the Clouded Yellow was found as far north as Angus. The high number of sunny days enabled each species to complete its life cycle in perfect conditions. The winter following has been one of the driest on record, dry winters being more favourable entomologically than wet ones. It is possible that some species *may* return to central Scotland and they should be looked for in the appropriate habitat. The Orange Tip frequents marshes and damp meadows where its foodplant. Lady's Smock *(Cardamines pratensis)* is common. The Speckled Wood is fond of shady lanes and woodland clearings while the Wall could appear anywhere. Therefore, if all the conditions were right, we could experience a spread in the range of many butterfly species and we could, once again, find in central Scotland *aegeria* in our woods, *megera* in our hedgerows and *cardamines* in our fields. There is nothing which could stop their spread to the localities which are apparently as suited to their needs now as they were a hundred years ago.

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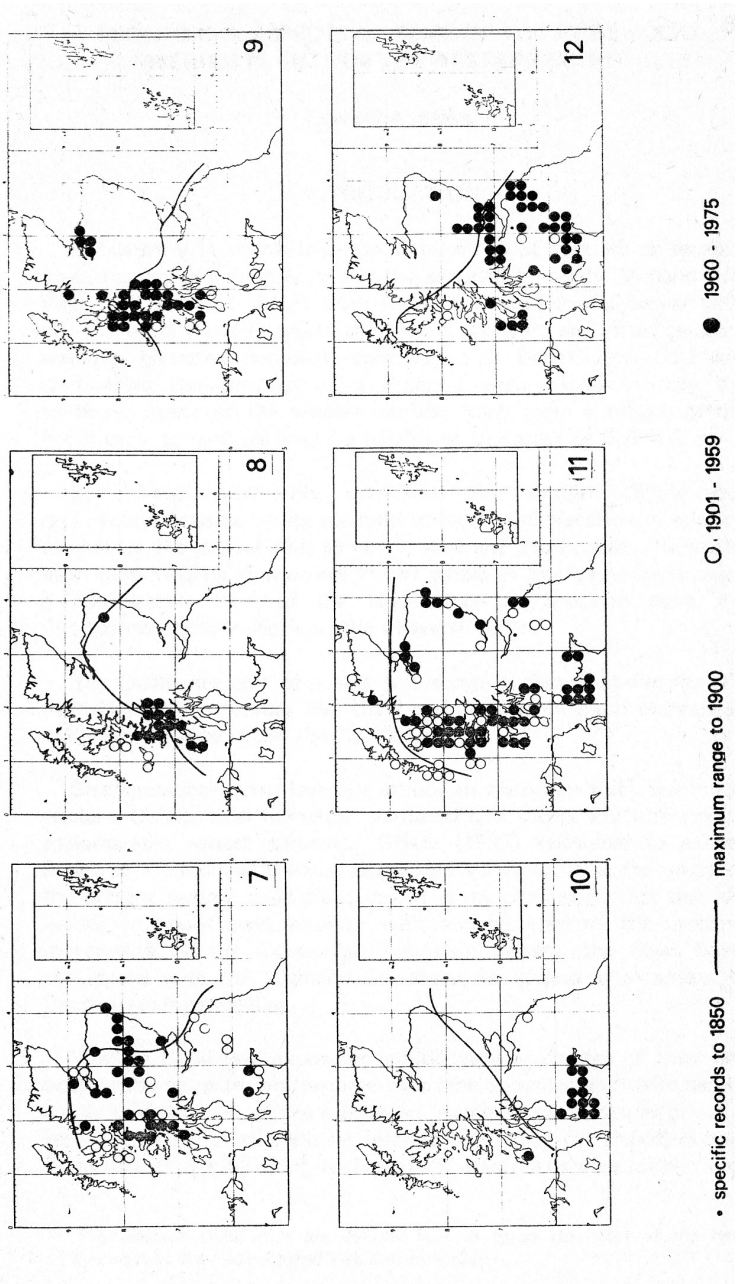
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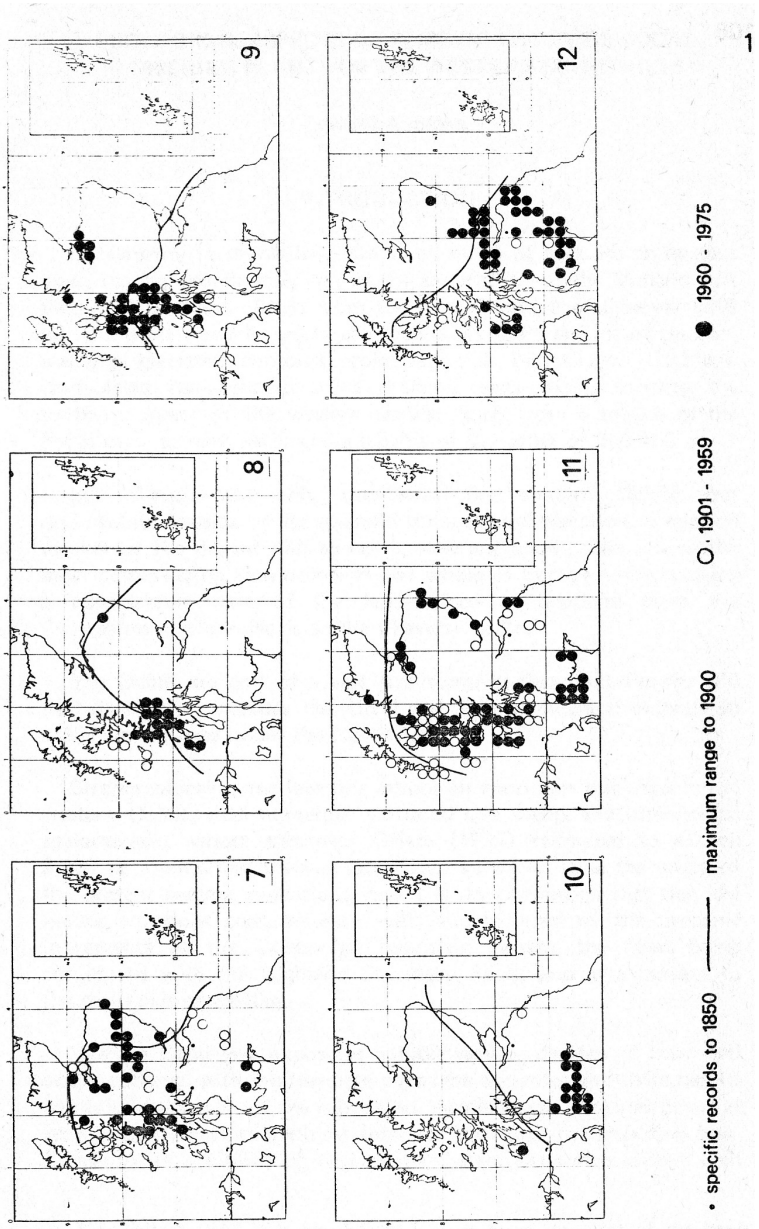
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ECOLOGICAL ASPECTS OF SOME OF THE MORE LOCAL FLOWERING PLANTS OF THE WESTERN OCHIL HILLS

Edward A. Blake.

INTRODUCTION

Noteworthy in themselves, the Ochil range of hills are an igneous mass, rearing prominently out of the eastern half of the Midland Rift Valley of Scotland. Apart from the rugged outline of Dumyat (418 m), the most westerly reach, the Ochils present a skyline of smooth, swelling, glaciated contours, culminating in Ben Cleuch (721 m). Up-faulting has resulted in a dramatic escarpment, forming the southern aspect of the western Ochils, rising from a tongue of the Forth carse at near sea-level, to heights of the order of 300-400 m. Ben Cleuch not only dominates the western Ochils [1], but remarkably, because of its splendid isolation and elevation in relation to that of the distant hills to north, west and south, gives one of the most commanding view-points in the whole of Europe, encompassing a considerable part of the land-surface of Scotland from the Cairngorms and Ben Nevis to the Cheviot border.

The Ochils are part of a vast lava complex that underlies the Old Red Sandstone, includes the Ochil and Sidlaw hills, and extends an unknown distance under the North Sea. Stratigraphically, the lava pile attains an enormous thickness in the western Ochils, with numerous extruded lava sheets and intercalated agglomerates, whose thickness Geikie (1897) estimated to exceed 2,000 m. Conflicting theories have been advanced as to the origin of the present magma exudations, but it is my contention that they are fissure emissions contemporary with and incurred by the orogenic movements of the Caledonian mountain system, the flows being contiguous with the Highland Boundary Fault, and at a tangent to the main axis of folding. Western Ochil lava exposures exhibit varying degrees of basic and acidic content, with intermediate pyroxene andesites and basic basalts comprising the bulk of the succession. Acidic trachyandesites occur at very infrequent stratigraphical intervals and form the imposing crag, Craigleith.

1 The western Ochil Hills are defined here as being that part of the range to the west of the Glen Eagles/Glen Devon Valley.

It is interesting that plants characteristic of acid soils such as frequent Bell-heather *(Erica cinerea* [2]*)* and locally Ling *(Calluna vulgaris)* root in fissures of agglomerates which are considered to contain mainly intermediate and basic fragments derived from underlying lavas.

It is clear from Smith (1974) that the climate of the western Ochils is very varied. The southern parts of the range form the northern rim of an enclosed lowland which is one of the warmest parts of Scotland. Data for the weather station at Stirling (Table 1) show relatively mild winter conditions followed by a rapid warming to give a high mean summer temperature. There will be an influence of altitude and aspect on the temperatures of the Ochils and the parts to the north will be much cooler. Data from the weather station at Glen Eagles (Table 1) contrasts with that from Stirling and shows a much harsher winter climate.

Likewise rainfall is very variable and ranges from a yearly mean of less than 1,000 mm at the foot of the southern part of the range (Smith, 1974) to over 1,780 mm in the highest parts. Rainfall figures (Table 2) from Falkirk (some 17 km to the south of the Ochils) indicate the seasonal distribution of the rainfall. Very high summer soil temperatures, probably comparable to those of mountains of Central Europe, occur on south-facing exposures where plants have been observed to experience severe drought e.g. the rolling of the leaves of Common Bent-grass *(Agrostis tenuis).* Some species, characteristic of dry soils, occur locally abundantly, such as Mouse-ear Hawkweed *(Hieracium pilosella)* on Craigleith.

Besides rock, soil and climate, biotic factors, including man, also influence the vegetation of the Ochil scarp. For example there is the evidence of Dickie (in this volume) of early terrace cultivation in certain areas, while cattle grazing has no doubt been practised over many centuries. High-pressure grazing, resulting from over-stocking of sheep, during the past two centuries or so, has greatly modified the vegetation of the scarp. There have also been widespread infestations of the rabbit (a species introduced into Britain), especially noticeable on the face of Dumyat, where the worst effects have resulted in large areas, from near sea-level to 300 m, virtually denuded of other than mosses and lichens, and showing top-soil erosion.

[2] Species names are taken from Clapham, Tutin and Warburg (1962

Table 1 Mean temperature 1931 – 1960 in °C (data from Smith 1974)

a mean maximum
b mean minimum
c mean

		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Stirling alt. 46 m	a	5.6	6.6	8.9	12.2	15.5	19.5	19.5	18.9	16.3	12.3	8.9	6.9	12.5
	b	0.3	0.8	2.3	4.0	6.3	9.4	11.3	11.1	9.1	6.4	3.2	1.8	5.5
	c	2.9	3.7	5.6	8.1	10.9	13.8	15.4	15.0	12.7	9.4	6.0	4.3	9.0
Gleneagles alt. 152 m	a	5.0	5.7	7.9	11.2	14.7	17.7	18.9	17.9	15.9	12.0	8.2	6.4	11.8
	b	–1.7	– 1.5	– 0.2	1.5	3.9	6.9	8.9	8.5	6.5	4.4	1.5	0.2	3.2
	c	1.7	2.1	3.9	6.3	9.3	12.3	13.9	13.2	11.2	8.2	4.9	3.3	7.5

Table 2 Monthly and annual average rainfall 1916 – 1950 in mm at Falkirk (Kerse) alt. 6 m. (data from Smith 1974)

a rainfall
b percentage of annual total

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
a	93	62	54	47	62	52	77	84	75	90	82	75	853
b	10.9	7.3	6.3	5.5	7.3	6.1	9.0	9.8	8.8	10.6	9.6	8.8	100.0

Despite a long history of human impact and the effects of sheep and rabbits, the Ochils still yield much floral wealth on their imposing southern escarpment, while the deep, wooded ravines are of interest, and not least, the great peat-mosses of the high interior. Over the past twenty years, I have made a study of the Ochil flora and have selected for discussion a number of species.[3] My criteria for selection vary; some are rare regionally or nationally, others are unusually abundant on the Ochils, or in the case of the Bird Cherry in a remarkable location.

COMMON ROCKROSE *(Helianthemum chamaecistus)*

This low shrublet has a largely eastern and southern distribution in Britain [3]. Usually a constituent of basic grassland, it demands a sunny and warm exposure and is therefore confined to the scarp. The Common Rockrose is abundant on the middle and mid-upper steep slopes of Craigleith between 150 and 350 m, where a broad banding of superimposed sheets of base-rich basalt occurs. Above this, it is of more sporadic occurrence to about 411 m, where Blaeberry *(Vaccinium myrtillus)* largely dominates the stunted sward. Mr. R. Cook (pers. comm.) has pointed out that it is frequent in an area known as "The Kips" on the eastern flank of Dumyat and locally abundant southwest of the summit of Myreton Hill. There are scattered individuals in a number of other places e.g. on the south face of Dumyat, in Balquharn Glen above the dam and the Silver Glen.

SEA CAMPION *(Silene maritime)*

This species is local inland and its only station in the western Ochils, known since the 19th century, is one of complete isolation. There is a sizeable colony two and a quarter km northwards along the ridge from Craigleith on a bold summit (550 m) outcrop of acidic, pyroxene-poor, leucocratic andesite. On this massive block-jointed crag the plants are rooted in south-facing vertical fissures and ledges of almost sheer rock.

COMMON STORKSBILL *(Erodium cicutarium)*

A plant of local inland occurrence in Central Scotland, it is locally frequent on Dumyat. At one site several plants are in proximity on an agglomerate ledge at 150 m whilst numerous plants grow on the steep, grassy slope below.

[3] My studies on the Red German Catchfly (*Lychnis viscaria*) are presented, jointly with those independently carried out by Wallis and Proctor, in the next paper

Westward two further rock sites occur at similar altitude. All are on crags with a south exposure, on two of which, the rarity, Red German Catchfly *(Lychnis viscaria),* is an associate and in one instance the local Awl-leaved Pearlwort *(Sagina subulata).* Common Storksbill also occurs on Dumyat along the line of sheep tracks. A diminutive form of the species occurs in scattered localities on the front of Myreton Hill (Mr. R. Cook pers. comm.).

CLOUDBERRY *(Rubus chamaemorus)*

This species has an upland, northerly distribution in the British Isles. An exceptionally large colony of nearly 2 km occurs in the western Ochils between the 500 and 580 m contours. The habitat, in the centre of the highest part of the range, is a large blanket-bog, a considerable area of which is undissected and active. Where dominant, the Cloudberry foliage completely carpets local areas, with only the occasional intrusion of plants such as Ling *(Calluna vulgaris)* or Crowberry *(Empetrum nigrum).* Over fairly large tracts, it is co-dominant with Wavy hair-grass *(Deschampsia flexuosa)* and Ling or Crowberry, with frequent Cotton-grass *(Eriophorum vaginatum),* Blaeberry *(Vaccinium myrtillus)* and *Sphagnum* and occasional Deer-grass *(Trichophorum cespitosum)* and Heath rush *(Juncus squarrosus).*

Flower and fruit production are sporadic although in some years may occur in quantity (R. Cook pers. comm.).

BIRD-CHERRY *(Prunus padus)*

In the western Ochils this widespread species has an unusually remote colony of 12 plants, 7 of which can be described as trees, on the 10 m high, east northeast facing andesite wall of a narrow ravine, at an altitude of about 425 m. The site is 100 m or so below the source of one of the head-waters of Alva Burn. Amid grassy, treeless surrounds, the narrow confines of the gorge, with a waterfall, provide a most attractive situation. No other shrub shares the dank site, although among a rich ground flora. Greater Woodrush *(Luzula sylvatica)* is abundant, Common Polypody *(Polypodium vulgare)* frequent, and Dovedale Moss *(Saxifraga hypnoides)* locally frequent.

Exposure has resulted in the trees being of tortuous trunk form and of various growth habits. Lateness in flowering, presumably a reflection of the

altitude and exposure, is indicated by a profusion of full-flower in mid-June 1969, after a heat-wave lasting the preceding week.

ENGLISH STONECROP *(Sedum anglicum)*

This species is very local, and with a maritime tendency, in eastern Britain. Its abundance in the western Ochils may date from periods of higher sea levels (Sissons in this volume) and be maintained by a favourable dry microclimate.

English Stonecrop is restricted to the southern aspect, along the scarp and locally, its immediate hinterland, while several isolated lava-outcrops, up to about 1 km inland, support small numbers of plants. Altitudinally, it ranges from the base of the scarp, to at least 427 m, and is fairly frequent on the summit of Durnyat (418 m). It is most abundant on the lower and mid-slopes, with two centres of density i.e. on Dumyat and Craigleith, the latter face supporting by far the largest quantity. It roots in rock fissures, and is also frequent in soil pockets and more continous thin soils. Locally, it is a pioneer of unstable soils on steep slopes with no other higher plants present. English Stonecrop seems generally immune to sheep and rabbit attack, persisting in quantity, in areas of high grazing pressure by both. However, where rabbit effects have been particularly sustained there is evidence that the species can be affected.

WALL-PEPPER *(Sedum acre)*

Widely distributed over much of the range of the previous species in the western Ochils, it is of more local occurrence, and does not grow to such a high altitude, nor extend so far eastward. It is restricted to steep or moderately-steep south exposures, and is rooted in fissures or in shallow pockets of soil. It tends to form pure colonies, occasionally of quite large dimensions e.g. I have observed one of 120m^2 on a 45° outcrop of agglomerate at an altitude of c. '90 m. While English Stonecrop may occur in proximity, it is rarely found within a population of the present species.

HAIRY STONECROP *(Sedum villosum)*

The upland limits of this montane species show a distinct central-northern tendency within the British Isles. It is widely distributed, in wet flushes, in the southern part of the Ochils although it is restricted to a few or more scattered plants at each site. In the northern Ochils it is much more local.

PENNYWORT *(Umbilicus rupestris)*

This species has a marked westerly distribution in the British Isles and the two colonies on Dumyat are extremely isolated. More than 30 plants, are fissure-rooted on the sheer south face of an agglomerate outcrop at 30 m. About 1 km from this site there is a second population, with c. 160 flower stems, on another south facing rock outcrop by a drive in the woods near Blairlogie House.

Some doubt must be cast on the native status of these plants however, as Mr. R. Cook has pointed out (pers. comm.), Great Leopard's-bane *(Doronicum pardalianches),* a known introduced species, grows near the larger colony.

MEADOW SAXIFRAGE *(Saxifraga granulata)*

This species is local and has an easterly tendency in Britain. I found several plants in lower Alva Glen in 1969, which constitute the only known site for the species in the western Ochils. At 152 m with an east aspect, the plants occurred at the foot of a very steep grassy slope, above a deep gorge.

DOVEDALE MOSS *(Saxifraga hypnoides)*

A species of the uplands of north and west Britain, it is widely distributed in the western Ochils from Tillicoultry Glen to the west flank of Dumyat. It is common in the Balquharn Glen above the dam, (Mr. R. Cook pers. comm.) in the upper reaches of Alva Glen, and locally abundant in the upper Wharry Burn.

LEAST WILLOW *(Salix herbacea)*

The Ochils station for this arctic-alpine with diminutive parts and characteristic, creeping, underground stem, is interesting on account of its remote location and apparently critical altitude. Isolated from the main area of distribution in Britain, which lies to the north and west, the Least Willow is found only on the summit of Ben Cleuch (721 m), although there are several heights approaching that of the latter, in the vicinity. A tendency to favour a northerly exposure, is revealed in that although widespread and abundant in places, it is restricted to within 1 m (vertical height) of the summit, on the south aspect, while growing down to 6 m below the summit on the north aspect.

The habitat area is gently rounded, with scattered rocks, more concentrated on the actual summit. Bare solifluction soils, in which stone polygons and stripes occur, are local, while a closed community, largely dominated by grasses of varying stature, prevails. Least Willow occurs frequently around the periphery of rocks, in a boulder-crack in one instance, and more or less profusely in short swards. Within the Least Willow zone, the following species of flowering plant occur. Abundant are Sweet Vernal-grass *(Anthoxanthum odoratum);* Sheep's Fescue *(Festuca ovina);* Brown Bent-grass *(Agrostis canina);* Meadow-grass *(Poa pratensis);* Wavy hair-grass *(Deschampsia flexuosa);* Tufted hair-grass *(D. cespitosa);* Mat-grass *(Nardus stricta);* Stiff Sedge *(Carex bigelowii);* Pill-headed Sedge *(C. pilulifera);* Heath Rush *(Juncus squarrosus);* Field Wood-rush *(Luzula campestris);* Heath Bedstraw *(Galium saxatile)* and frequent Blaeberry *(Vaccinium myrtillus).* Occasional are Cowberry *(V. vitis-idaea)* and Common Tormentil *(Potentilla erecta).* Local are Sheep's Sorrel *(Rumex acetosa)* and Harebell *(Campanula rotundifolia),*- while *Polygonum viviparum* is rare.

Both Stiff Sedge and *Polygonum viviparum* are montane species and like the Least Willow are isolated from their main centres of distribution.

CONCLUDING REMARKS

In presenting these observations I hope to have drawn attention to the botanical interest of the western Ochils. My choice has been of a few interesting species; there are many more that merit discussion. There is much scope for further botanical study, and it would be particularly gratifying if old records for plants such as Yellow Marsh Saxifrage *(Saxifraga hirculus)* could be reconfirmed although it must be feared that some of the Ochil rarities are now extinct. More detailed, ecological investigations of the flora are needed and current research into the woodlands of the western Ochils should be extended to other habitat types.

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THE RED GERMAN CATCHFLY ON THE WESTERN OCHIL HILLS

Edward A. Blake, Peter R. Wallis and John Proctor

INTRODUCTION

The Red German Catchfly *(Lychnis viscaria* L.)* is an attractive and rare native British species which, apart from two Welsh localities, is restricted to Scotland. The species has a wider distribution on the continent, where it is found in a range of habitats, including dry sunny meadows, stony slopes, vineyards and well-lit parts of forests. In the north of its range the Red German Catchfly is confined to scattered localities, usually on south facing slopes. Jervis and Pigott (1973) pointed out that the British localities for the species have several characters in common. They are generally on the eastern fringes of Highland Britain, in regions of relatively low rainfall, on basic igneous rock or conglomerate and have several unusual, or unusual combinations of, plant species. The western Ochil Hills (whose geology and climate have been discussed by Blake in this volume) provide a favourable habitat for the species.

NUMBERS AND DISTRIBUTION

Intensive surveys have been carried out eastwards from Stirling University campus, as far as Dollar. These revealed that in the western Ochils, the plant's range extends about 7 km from west to east, from above Logie to Alva, with an altitudinal range from 107 m to 366 m (the latter height on Craigleith). Beyond Dollar, suitable rock exposures are infrequent and occurrences of the Red German Catchfly less likely. There is a population in Glen Farg in the eastern Ochils some 21 km north-east of Dollar and the west Ochil population is thus isolated. Old records for the species at Abbey Craig (e.g. Forrest 1831) were investigated but not confirmed. Most of the plants are very difficult of access and the greater part of the survey was carried out with the aid of binoculars. Only established (i.e. at least 1 year old) plants were counted and found to vary in size from single stems to clumps, over 60 cm in diameter, of over 100 separate stems. The vast majority of plants are rooted in fissures in the rocks and only a small proportion grow in visible soil. The counts have shown that Dumyat is the main centre of distribution, with a total of 810 plants (Blake), between the contours 150-350 m.

*Species names are taken from Clapham, Tutin and Warburg (1962)

Craigleith, the most recently discovered site, has 214 plants (Blake and Wallis), whilst there are a further 143 plants above Blairlogie (Blake), 25 on Yellow Craigs (Wallis), 2 on Myreton Hill (Wallis), and a single plant in Menstrie Glen (Wallis). The total number of individuals counted was 1195 and we believe that this may represent the largest number at any British station.

The aspect preferences of the Red German Catchfly show a distinct southerly tendency. On Craigleith Crag, all the plants, and above Blairlogie, 97% of the plants were on substrata facing south south west to south south east. On Dumyat, a survey of all the plants (Table 1) showed that 53.5% had this southerly exposure although 15.5% each faced southwest and southeast. Here there is a wide tolerance of aspect, with at least one plant with a northwest exposure having flowered in 1975.

The plants grow on several rock types and have been recorded on acid porphyrite, agglomerates (including tuff), basalt lava, pyroxene andesite and trachyandesite. The vast bulk of Dumyat consists of agglomerates, and most plants (749 on Dumyat, 177 on Craigleith) are growing on this substratum. There is no affinity for heavy metal ores, an observation which agrees with the results of experiments by Jervis and Pigott (1973) who showed no peculiar trace element requirements for this species.

ASSOCIATED SPECIES

There are many similarities between the associated plants of the Red German Catchfly on the western Ochils and those for a site in Wales recorded by Jervis (1974). The rare plants of southerly distribution noted by Jervis are absent from the Ochils and do not occur anywhere in Scotland. Jervis noted that plants typical of base-rich soils (calcicoles), and plants typical of base-poor soils (calcifuges) are frequently juxtaposed at the Welsh site, and this unusual phenomenon can also be observed on the Ochils. Meadow Oat (Helictotrichon pratense) and Common Rockrose (Helianthemum chamaecistus), are examples of calcicoles which grow with such calcifuges as Bell-heather (Erica cinerea), Broom (Sarothamnus scoparius) and Heath Bedstraw (Galium saxatile).

POLLINATION AND SEED PRODUCTION

The observations of Wallis on about a third of all the plants

suggested about half of the individuals flowered in 1974. Most flowers were produced from May to July with a few late individuals in September and October. The flowers are pollinated by a range of insects and observations at the Glen Farg site have shown that the long tongued hoverfly (Rhingia campestris), short tongued hoverflies (Melanostoma spp.), Lepidoptera and bees, function in this respect. There is no doubt that the plants attract many pollinators and, even in their absence, viable seed can be produced following self-fertilisation. In a field experiment by Wallis in 1974 five flowering spikes of the Red German Catchfly were enclosed in plastic bags before the flowers opened. Cross-pollination was thereby prevented yet seeds were produced, of which about 70% could be rapidly germinated in the laboratory. This figure is not significant less than that for control plants which had been left unbagged. Flowering plants, fruit capsules per plant and seeds per capsule were counted and the viable seeds produced per annum calculated. Assuming 1974 was not an exceptional year for seed production this showed that large numbers, probably hundreds of thousands, are produced per annum.

An unusual feature of the species' pollination biology is worthy of note. The Red German Catchfly has viscid patches, below each node of its flowering stems, which cause the plants to feel sticky. This was suggested by Kerner von Marilaun (1878) to be an adaptation to prevent pollen and nectar stealing by non-pollinating insects. The sticky stems seem very effective and small invertebrates have often been seen adhering to them. Similarly sticky stems are found in a number of related species, hence the origin of the English name "Catchfly".

LOCAL DISTRIBUTION

There are several places in the western Ochil Hills which seem suitable for the Red German Catchfly, but from which it is absent. In view of the high annual viable seed production, it seems that a failure of seed dispersal and/or seedling establishment must be important in keeping the species population from increasing. Numerous seedlings have been observed on the slopes below the mature plants. These seedlings generally fail to survive, and there are a number of possible causes for this, among which the high summer soil surface temperatures and water deficits are likely to be important. Jervis (pers. comm.) has observed a similar high mortality of seedlings at the Craig

Breidden site in Wales. He found for example that on one small ledge there were about 250 seedlings in early spring but by September only one remained. From his observations it appeared that on the dry thin-soiled ledge sites of Craig Breidden the plants that germinated in autumn were the most likely to establish. It would be an interesting study to follow the fate of Red German Catchfly seedlings in the western Ochils.

The rates and possible causes of mortality of adult plants are not fully known. Sheep have been observed grazing more accessible plants on a number of occasions, although rabbits, abundant in the vicinity of the plants, have not been seen to eat them. The cliff ledge and crevice habitats may be favoured in part at least because of their inaccessibility to sheep. It might be suspected that the extension of sheep grazing has reduced the range of the Red German Catchfly. However, in the absence of grazing, other herbs would increase in height and probably shade out the individuals of the rare species growing in soil. Since this is likely to have been the situation in primeval times, it may be that the Red German Catchfly has continued to occupy its present habitats in the western Ochils with relatively little fluctuation in numbers.

Apart from the mystery of the species' absence from areas with apparently the right conditions of rock type and microclimate, both within the Ochils and in Britain as a whole, there is the more fundamental question of why the species demands such conditions. Jervis and Pigott (1973) investigated the species' affinity for basic igneous rocks. They indicated that such soils supply sufficient major nutrient requirements in contrast to soils of more acid or calcareous substrata. They pointed out however "it is difficult to believe that there are not other soils which would provide suitable conditions" and are forced to conclude that "it would seem that ledges on unstable cliffs provide some other requirements for the species which remain unidentified". There are obviously important aspects of Red German Catchfly distribution awaiting further research.

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TABLE 1

Distribution, according to aspect, of Red German Catchfly on Dumyat

Aspect	NNW, N, NNE	NW	WNW	W	WSW	SW	SSW, S, SSE	SE	ESE	E	ENE	NE
No of plants	0	6	4	31	33	126	434	126	2	20	19	9

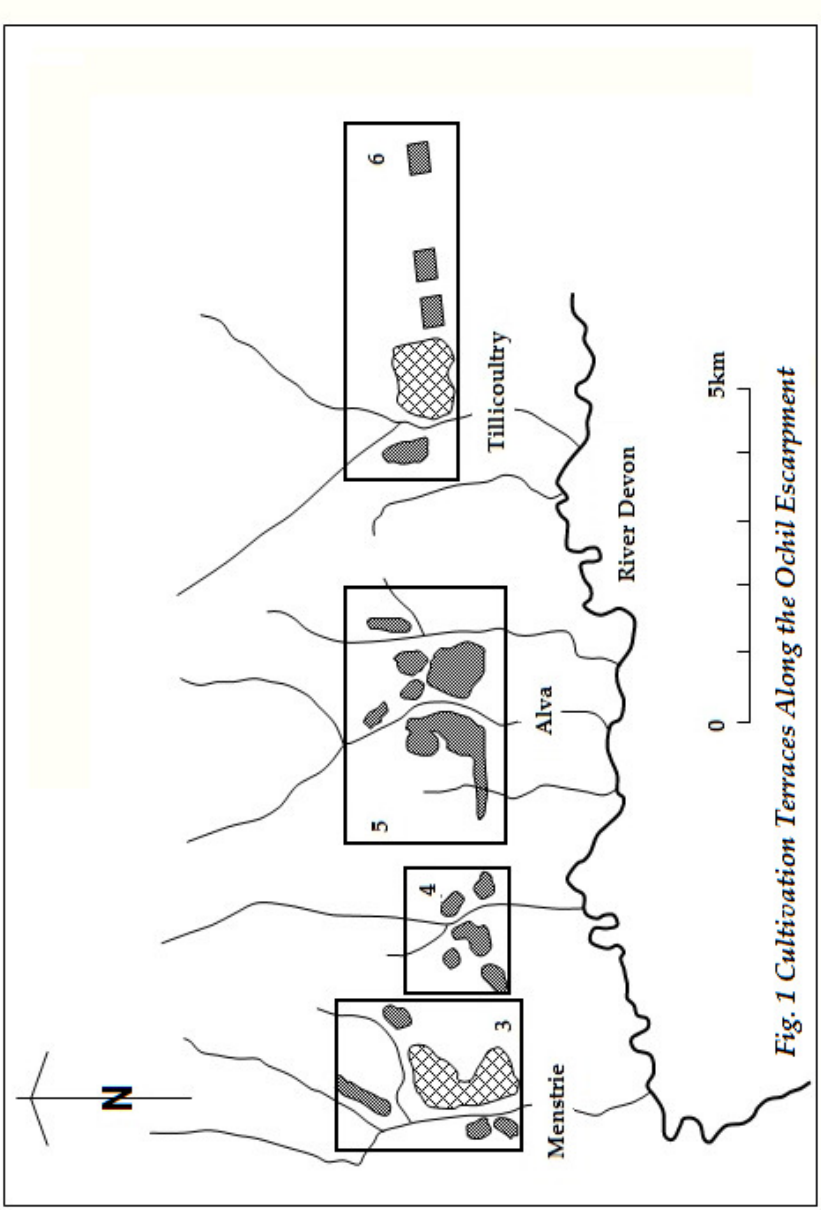

Fig. 1 Cultivation Terraces Along the Ochil Escarpment

CULTIVATION TERRACES ALONG THE OCHIL ESCARPMENT

A PRELIMINARY SURVEY

D. M. Dickie

The Ochil Escarpment, running from Blairlogie in the west to Dollar in the east, presents a dramatic south-facing wall of resistant rock against the edge of the low-lying carselands and valley of the River Devon. The escarpment is related to extensive earth movements along the line of the Ochil Fault (Francis, 1970) and is broken in a number of places by deeply incised valleys, or glens, which penetrate several miles into the Ochil Hills.

On the face of the escarpment and on the shoulders of the glens there are a considerable number of terrace-like features certain of which have previously been identified and mapped as cultivation terraces (Graham, 1939). The terraces are characteristically step-like, usually running slightly across the contours rather than being horizontal in attitude and commonly are arranged in small sequences. The relative theories regarding the possible formation of cultivation terraces in the Scottish Borders and Central Lowlands were set out in detail by Angus Graham in the Proceedings of the Society of Antiquaries. He concluded that although the exact manner of formation might vary, these terraces were created for, or by cultivation; specifically by the down-slope movement of soil associated with lateral ploughing or digging. Although he pointed out that large areas of cultivation terraces appeared to have been destroyed by more recent cultivation, the local distribution seemed to indicate no particular control being exerted by elevation or aspect while general distribution pointed to Northumbria as a likely place of origin. Regarding dating, he suggested very long-term usage, as early as the Roman Period into the Medieval Period, although the lack of any written record of their use suggested that they were abandoned by the middle, if not the beginning, of the Seventeenth Century. Later authors have suggested that the terraces in South-West and Central Scotland were developed either immediately prior to (Stevenson, 1947), or during the Medieval Period (Crawford, 1953).

The formation of cultivation terraces is related to the down-slope movement, either by design or by accident, of soil, when this takes place during the cultivation of a series of lateral strips as in Fig. 2,

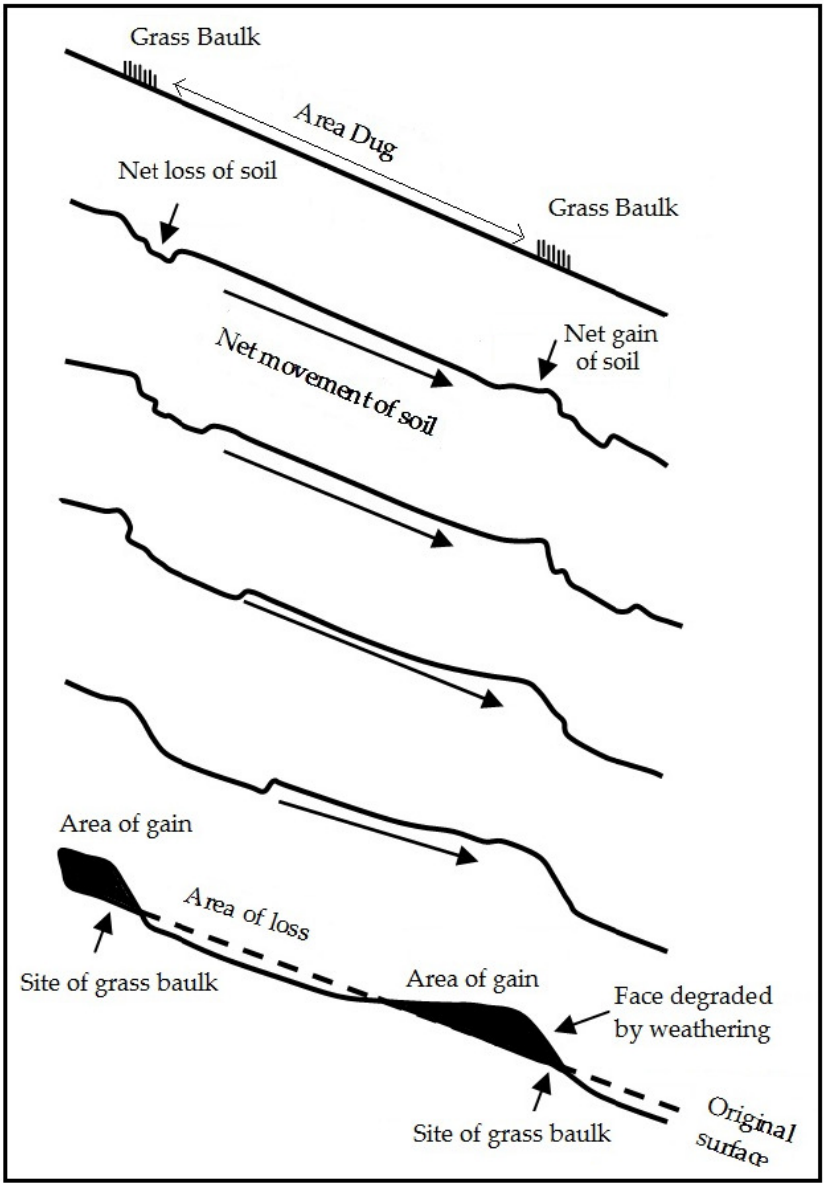

Fig. 2 Creation of a Cultivation Terrace

There is a net gain of soil at the base of each strip and a net loss of soil at the top. The continued cultivation of the strip then results in an accumulation of soil to form a terrace. A series of lateral strips would therefore, intentionally or otherwise, gradually form a sequence of terraces, as Fig. 3. The ultimate height of the front of the terrace will obviously depend on two factors; the original width of the strip and the length of time cultivation took place. The wider the strip and the longer the time, the higher will be the front of the terrace.

It was pointed out as early as 1928 (Eckford, 1928) that cultivation terraces were rarely perfectly level, a conclusion completely borne out by the attitude of the Ochil terraces which generally vary between five and ten degrees from the horizontal. Eckford attributes the slight tilt to the builders' experience of soil drainage and the danger of a completely horizontal terrace holding back surface water and souring the soil of the terrace. This conclusion is supported by local observations, particularly on the western shoulder of the Silver Glen at Alva, where water from springs comes onto terrace surfaces and is drained away by the slight tilt.

This tilt is one of the main characteristics which can be used to differentiate between terraces due to cultivation and natural terraces resulting from soil-creep, of which there are extensive areas in Balquharn, Alva and Dollar Glens. These soil-creep features, often exaggerated by their use as sheep walks, are parallel to the contours and have a much more regular pattern than do cultivation terraces. Further, the soil-creep features are associated with steep, grassed slopes, while terraced features are on gentler slopes, most of which have in the recent past been colonised by bracken.

It is this spread of bracken which has made the identification of cultivation terraces particularly difficult, as vigorous plant growth is capable of disguising the minor features created by terracing. The task of identification and plotting is restricted to winter and spring when the bracken cover is reduced. Even then, certain terraces have defied identification except under peculiar conditions (a) of climate where a thin snow cover is in the process of decay; or (b) of illumination, where terraces are subjected to shallowly inclined, strong sunlight. This difficulty of identification, together with the problem of the possible superimposition of later types of cultivation make it certain that the maps and figures which follow cannot be considered to be definitive.

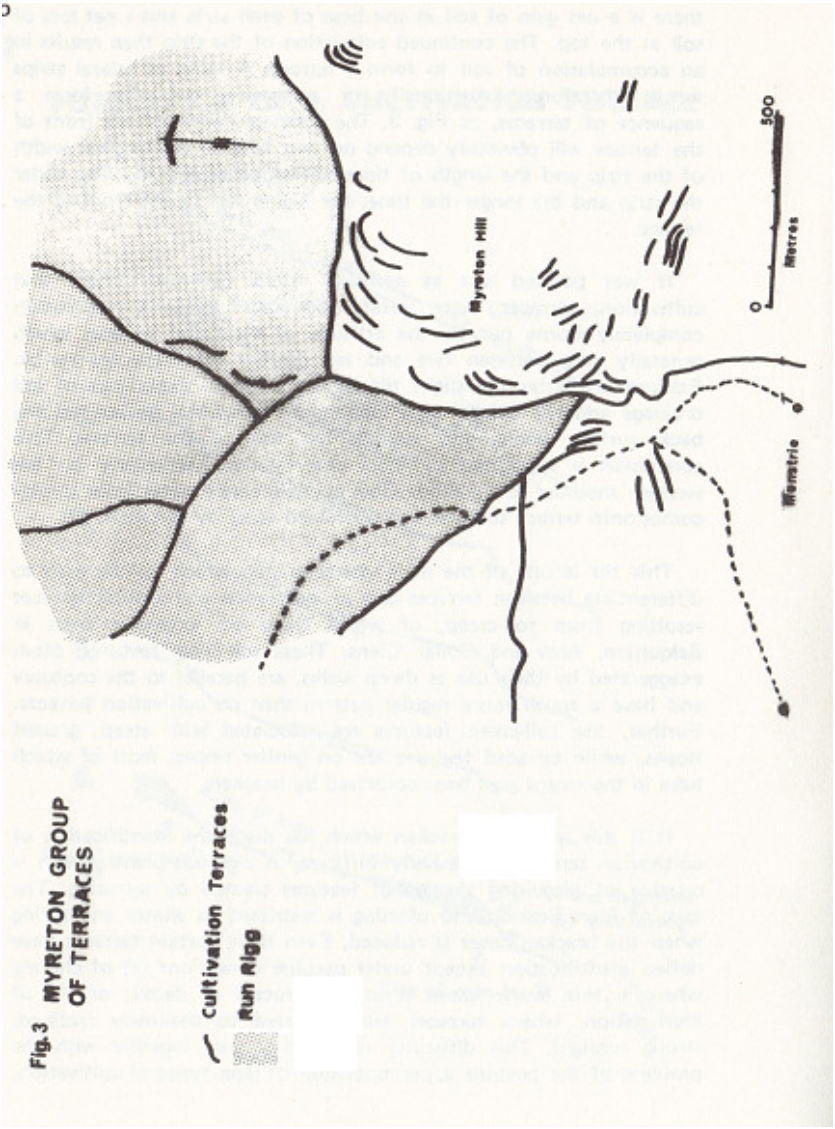

Fig.3 MYRETON GROUP OF TERRACES

The distribution of cultivation terraces suggests the existence of four major groupings; the southern and western slopes of the Myreton Hill behind Menstrie; the area at the entrance to Balquharn Glen; the hill slopes and shoulders behind Alva including Little Torry and the Nebit; and the area between Tillicoultry Glen and Harvieston Glen.

The Myreton Group (Fig. 3)

Menstrie Glen, unlike the other glens along the Ochil Escarpment, opens out as it penetrates the hill mass to form an extensive area of gently sloping land. The eastern part of this area, which forms the western slopes of the Myreton Hill, together with the part of the escarpment which forms the southern slopes of the Myreton Hill, is the site of the second largest concentration of cultivation terraces.

As indicated in Fig. 3, there is a large area of late Medieval run-rigg system to the West and this more recent cultivation may have been superimposed on top of earlier cultivation terraces. There are a number of features within the run-rigg area which are suggestive of such earlier terraces but considerable detailed excavation will be required to establish their exact nature. There are 79 identifiable terraces within the area, with an altitudinal distribution from 80 to 360 metres, although the bulk of them lie below 225 metres. The average length of terraces in this group is 91 metres.

This group of terraces is adjacent to the Hill Fort on the western shoulder of Dumyat (Royal Commission on Ancient Monuments, 1963), a juxtaposition common in a number of terrace groups in other parts of the country {Kilbride Jones, 1933). The terraces are also associated with three pathways; the access track from Blairlogie Village to the Lossburn Reservoir, the hill-path from Menstrie to Jerah Farm, and the pony trail from Menstrie to the open-cast calcite mines on the Myreton Hill (Dickie, 1974).

The hill-path running up the western side of Menstrie Glen is particularly interesting in that it is deeply incised into the hillside and shows more than one route in places, while the late Eighteenth or early Nineteenth Century pony trail may well conceal an older routeway.

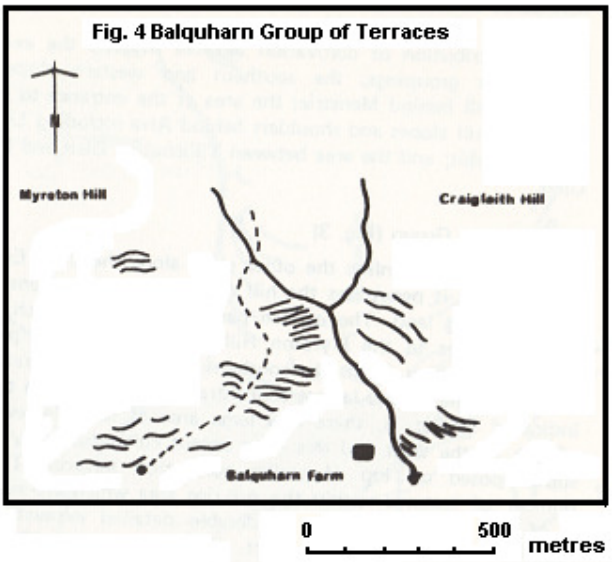
Fig. 4 Balquharn Group of Terraces
Myreton Hill
Craigleith Hill
Balquharn Farm
0
500
metres

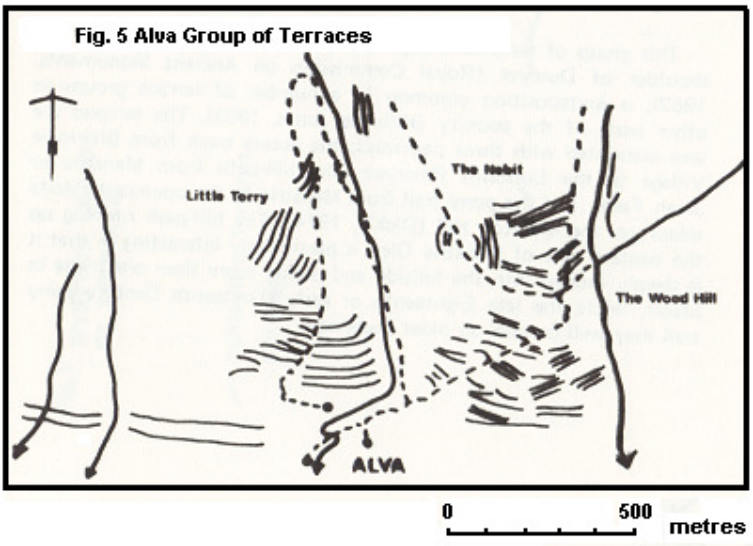
Fig. 5 Alva Group of Terraces
Little Terry
The Nobit
The Wood Hill
ALVA
0
500
metres

Balquharn Group (Fig. 4)

Moving eastwards along the escarpment to Balquharn Glen, there are a series of terraces on the western shoulder of the glen associated with a well-marked pathway from Myreton House. Another group on the base of the eastern shoulder of the glen has been severely eroded by recent quarrying operations but a few remnants indicate the existence of a sequence on the lower shoulders and eastern sides of Balquharn Glen. This sequence once extended to the South of the Ochil Fault where they were developed on a gravel fan rather than on the main hillslope. (These terraces are shown complete on aerial photographs taken at an earlier date (RAF, 1947)).

The pathway from Myreton House runs through the terraces rather than across them, in contrast to the path from Balquharn Farm up the western shoulder of the glen which runs directly across two sets of terraces. This would suggest that the former path is contemporaneous with, or older than, the terraces while the latter is a more recent addition.

There are clear indications of dwellings adjacent to the uppermost terraces on the western side of Balquharn Glen, and their association with the terraces and the Myreton House pathway will require further investigation. The contrast between the open nature of the area behind Menstrie and the enclosed situation of Balquharn Glen is reflected in the much narrower limits of orientation displayed by terraces in the latter group; this being restricted to South East, South and South West.

Alva Group (Fig. 5)

The escarpment behind Alva is at its maximum development and is broken over a short distance by two major glens, Alva Glen and the Silver Glen. These two glens separate three hill masses; from West to East, Little Torry, Alva Glen, the Nebit, Silver Glen and the Woodhill. There are easily observable, extensive areas of cultivation terraces on the lower slopes and shoulders of Little Torry and the Nebit; but the Woodhill, with a thick covering of coppice, has so far defied attempts to identify terracing. The terraces behind Alva can therefore be divided into two sub-groups; Little Torry and the Nebit sub-groups. The Little Torry sub-group was the first of the Ochil Escarpment terraces to be identified (Graham, 1939), principally due to the existence of a very regular sequence just above the glen entrance.

In common with the observed pattern of the preceding groups the Little Torry sub-group is associated with a diagonally inclined hill path. (N.S.884974 to N.S.884982). Again the distribution of terraces on either side of the middle sections of this path indicate that the line of the path is contemporaneous with or older than the terraces (Graham, 1939).

The path became incorporated in a circular route during the "improvement" of Alva Glen in the Nineteenth Century and it is certain that the upper section, which cuts across two terrace sequences, is definitely of modern age, while the lower section, which crosses back over the line of the Ochil Fault, may also be a modern addition.

Apart from the outstanding regularity of the sequence at the glen entrance, these terraces are the largest and best developed of all the terraces so far identified (N.S.884977). Six well-stepped terraces follow the shoulder of the hill into Alva Glen. Developed on a slope of 1 in 2.3 the terrace edges are approximately 32 metres apart and vary in height from 3 metres to 1 metre.

This sequence is also interesting in that it demonstrates the association between terraces and the pathway. The path is clearly embanked with respect to the terraces and separates the major group from an entirely different pattern of terraces. The sequence of six has been investigated with a thin steel probe and it is clear that there is an area behind each terrace edge, extending to approximately half the width between terrace edges, where the depth of the top soil is greater than 1 metre, while on the remaining area behind, the top-soil depth is less than 0.25 metres.

Extensive probing failed to reveal the existence of any stones larger than 2 or 3 centimetres in length (substantiated by the observation of rabbit burrow spoil) on the area of accumulated top-soil on the terrace surface proper, although the faces of terrace edges appeared to be much stonier. This latter observation may accord with discoveries in other areas where excavation has revealed the existence of stone concentrations in front of the terrace edges (Eckford, 1928). The sequence, in common with all other terraces, is markedly inclined from the horizontal. The effect of terracing on the slope of the cultivated areas was noticeable but, even on the terrace with the highest front edge (3 metres), the reduction in slope was less than 25%. Much more significant was the considerable increase in the depth of top soil.

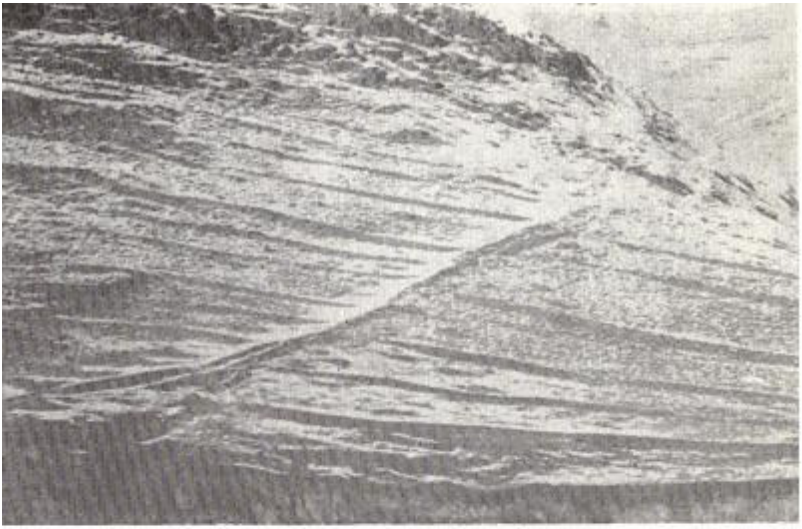

Plate 3. Main group of terraces behind Alva, with diagonal path

Plate 4. Alva, showing the distribution of Carnaughton Glen, Little Torry and the Nebit terraces.

By far the most significant point to emerge from a study of this sequence, however, was the discovery of the remains of a very substantial hill-dyke running across the main sequence, the path and the adjoining sequence. This dyke, composed of very large stones, has a base of some 2 metres in width and runs approximately 750 metres from Alva Glen (N.S.886977) to the head of a small gully above the Golf Course (N.S.881975). It is likely that this dyke was the original head-dyke for the village of Alva, enclosing the common grazing area of the villagers and dating from at least the early Eighteenth or late Seventeenth Centuries. The existence of this dyke points to the abandonment of the best-developed terrace sequence along the Ochil escarpment by the late Seventeenth or early Eighteenth Centuries, at the latest.

The Little Torry sub-group is also important in that it contains two very large, clearly observable terraces below the line of the Ochil Fault on the broad apron of gently sloping land at the foot of the hill. (N.S.877973). These terraces, which lie to the west of the Carnaughton Burn, appear to have continued eastwards over what is now Alva Golf Course, creating the two largest single terraces yet observed. The existence of these two terraces, together with the remnants around the gravel quarry at Balquharn Glen, raises the question of the possible existence of extensive areas of cultivation terraces along the entire length of this apron of land. Apart from the two sites mentioned, the whole of this area has been cultivated up to very recent times and any previous terrace features would now be extremely difficult to identify. Only detailed excavations will be able to resolve the question of the possible existence of an extensive area of low-lying terraces of which the terraces at Alva Golf Course might only be a remnant.

The Nebit sub-group covers most of the face of the escarpment and extensive areas of the shoulders of Alva Glen and the Silver Glen. It is associated with a diagonal hill path starting from the entrance to Alva Glen (N.S.887974). This path, which is one of the main trans-Ochil routeways, has of late become very wide and its edges now cross the ends of terraces, but it is clear that it once was routed between, rather than across, them. It exhibits, in its middle reaches (N.S.891978 - N.S.891990), the deeply incised, multiline characteristics exhibited by the other pathways. At a level of about 200 metres (N.S.891980) a branch leaves the main pathway and crosses the face of the escarpment, following the contours closely and running along the shoulder of Alva Glen. This path corresponds roughly to the top section of the Little Torry pathway and gives access to the terraces on the shoulder of Alva Glen.

The Nebit terraces are also crossed by a hill-dyke of considerable antiquity, connecting Alva Glen (N.S.884982) to the Silver Glen (N.S.891982). This dyke, at its eastern end, connects to a double head-dyke on the Woodhill and may relate to an estate enclosure of a similar period to that of the dyke across the Little Torry terraces.

Taken as a whole, the Alva Group is the largest and best-developed group in the area, containing some 41% of the identifiable terraces in terms of numbers (110 terraces) and approximately half of the terraces in terms of length (14.8 kilometres). It exhibits, in common with the Myreton Group, a wide spread of orientation but shows a marked preference towards the South East, South and South West, reflecting the site importance of the face of the escarpment and the hill shoulders.

Tillicoultry Group (Fig. 6)

This group divides into four very distinct sub-groups; Tillicoultry Glen, Kirk Glen, Harvieston Glen and Whitehillhead Glen. In each case a small group of terraces lies on the eastern side of a glen and is associated with a diagonal hill path. The Tillicoultry Glen sub-group (N.S.910980) is the largest, with 14 terraces spreading from 240 metres O.D. to 330 metres O.D. There are four distinct sequences of terraces, three above the path and one below it; and their orientations, restricted to east and south east, reflect the small extent of the site.

Prior to the development of the Castle Craig Quarry a large, broch-like ruin stood on a knoll to the east of the path and separated from the path by a well marked ditch. The outline of both ruin and ditch are shown very clearly on pre-1950 aerial photographs, the ruin being circular and of some 30 metres in external diameter and 20 metres internal diameter (RAF, 1947).

The ditch, lying about 20 metres away from the ruin describes a semi-circle from north east to south west and crosses the ridge between the main hill-mass and the knoll. The situations, and dimensions of this feature taken in conjunction with descriptions of its state prior to its disappearance certainly point to it being a defensive structure (Royal Commission on Ancient Monuments, 1933) and it may well have been, as has been suggested, a broch. This would be in accordance with the observed association between cultivation terraces and brochs in other parts of the country (Kilbride Jones, 1933).

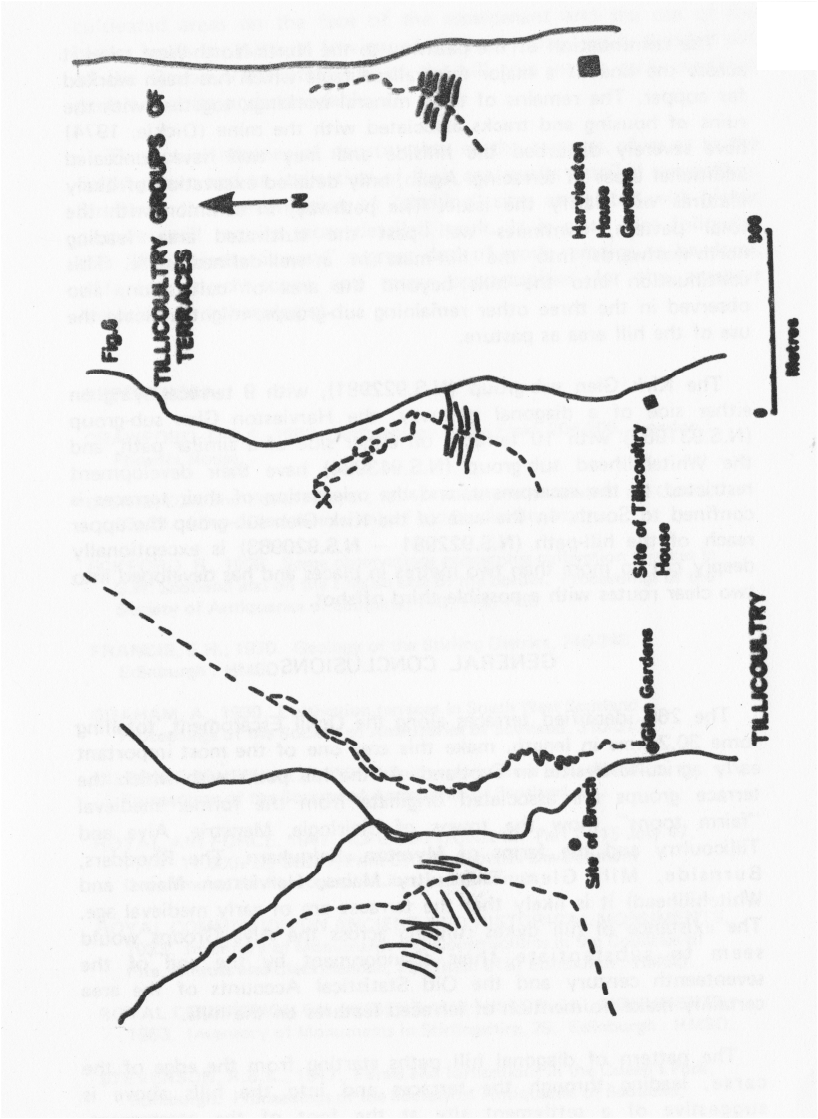
Fig.6
TILLICOULTRY GROUPS OF TERRACES
N
Harviestoun House Gardens
Site of Tillicoultry House
Glen Gardens
TILLICOULTRY
Site of Beech
100
Metres

The continuation of the pathway to the North-North-West takes it across the line of a major mineralised fault which has been worked for copper. The remains of these mineral workings, together with the ruins of housing and tracks associated with the mine (Dickie, 1974) have severely disturbed the hillside and may well have concealed additional areas of terracing. Again, only detailed excavation of likely features will clarify the issue. The pathway, in common with the total pattern, continues well past the cultivated area, leading north-westwards into the hill-mass in a well-defined state. This continuation into the hills beyond the area of cultivation, also observed in the three other remaining sub-groups, might indicate the use of the hill area as pasture.

The Kirk Glen sub-group (N.S.922981), with 9 terraces lying on either side of a diagonal pathway, the Harvieston Glen sub-group (N.S.931982) with 10 terraces on either side of a similar path, and the Whitehillhead sub-group (N.S.943984) have their development restricted to the escarpment; and the orientation of their terraces is confined to South. In the case of the Kirk Glen sub-group the upper reach of the hill-path (N.S.922981 - N.S.920983) is exceptionally deeply cut to more than two metres in places and has developed into two clear routes with a possible third off shot.

GENERAL CONCLUSIONS

The 269 identified terraces along the Ochil Escarpment, totalling some 30.2 kms in length, make this area one of the most important early agricultural sites in Scotland. As the hill paths with which the terrace groups are associated originate from the former medieval "fairm toons" (now the towns of Blairlogie, Menstrie, Alva and Tillicoultry and the farms of Myreton, Balquharn, The Rhodders, Burnside, Mill Glen, Tillicoultry Mains, Harvieston Mains and Whitehillhead) it is likely that the terraces are of early medieval age. The existence of hill dykes running across the Alva Groups would seem to substantiate their abandonment by the end of the seventeenth century and the Old Statistical Accounts of the area certainly make no mention of terraced features on the hills.

The pattern of diagonal hill paths starting from the edge of the carse, leading through the terraces and into the hills above is suggestive of a settlement site at the foot of the escarpment, cultivated areas on the face of the escarpment and the use of the higher levels for pasture. In view of the heavy clay, easily flooded soil of the Devon Valley this use of the hill area in the

early medieval period is quite understandable.

The actual manner of construction of the terraces, clues as to the crops grown and an indication of their age awaits detailed excavation. Similarly, the identification of "sheiling" sites associated with higher pastures will require more detailed work. It is clear that following this "Preliminary Survey" a great deal of work remains to be done, offering much scope and many opportunities for the amateur historian or archaeologist.

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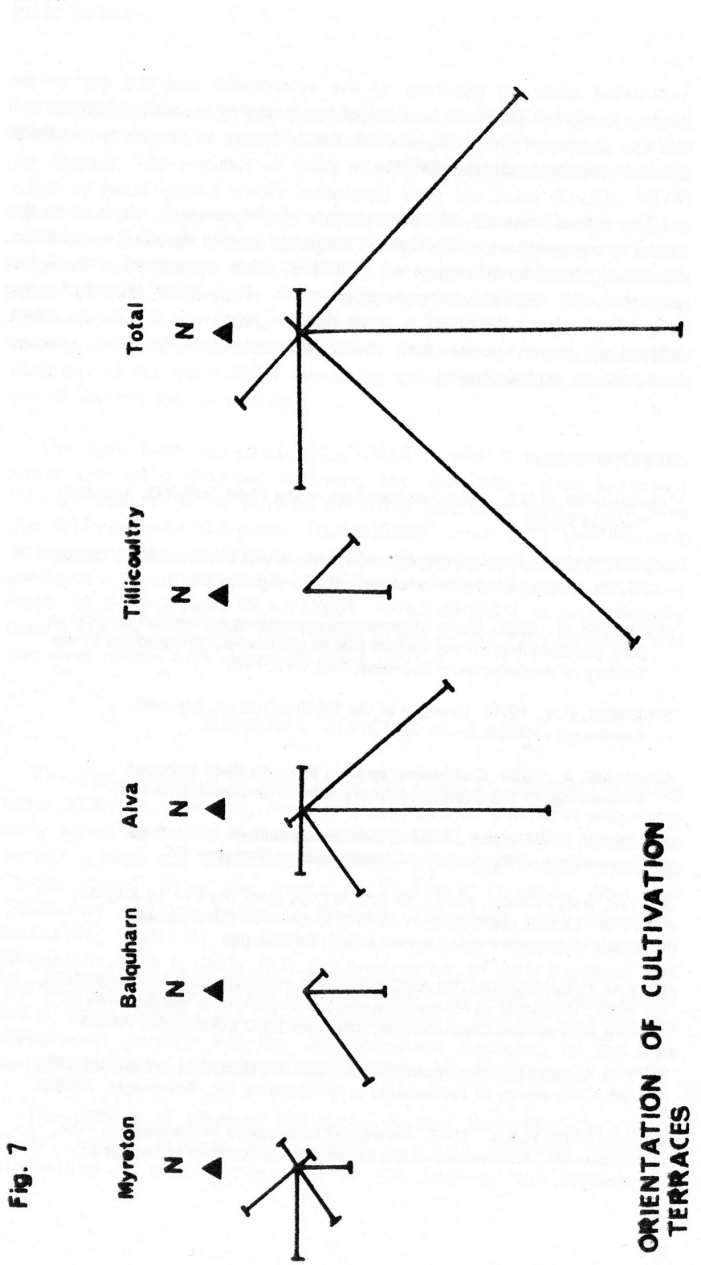

Myreton
N
Balquharn
N
Alva
N
Tillicoultry
N
Total
N
ORIENTATION OF CULTIVATION TERRACES

Fig. 7

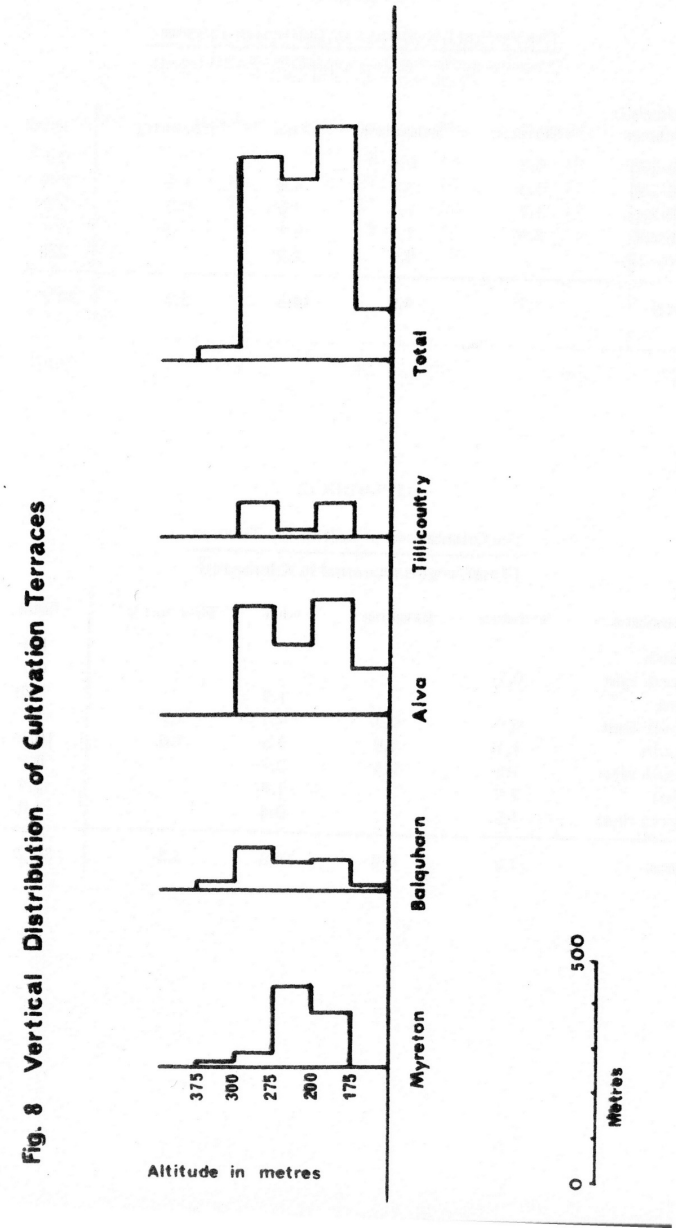


Fig. 8 Vertical Distribution of Cultivation Terraces
Altitude in metres
375
300
275
200
175
Myreton
Balquharn
Alva
Tillicoultry
Total
0
500
Metres

APPENDIX I

The Vertical Distribution of Cultivation Terraces

(Total length of Terraces expressed in Kilometres)

Altitude in metres	Myreton Total	Balquharn		Alva	Tillicoultry
300-375	0.3	0.4			0.7
225-300	0.8	1.9	4.8	1.5	9.0
1 50-225	3.7	1.1	3.0	0.2	8.0
75-150	2.4	1.3	5.1	1.6	10.4
0- 75		0.2	1.9		2.1
Total	7.2	4.9	14.8	3.3	30.2

APPENDIX II

The Orientations of Cultivation Terraces

(Total lengths expressed in Kilometres)

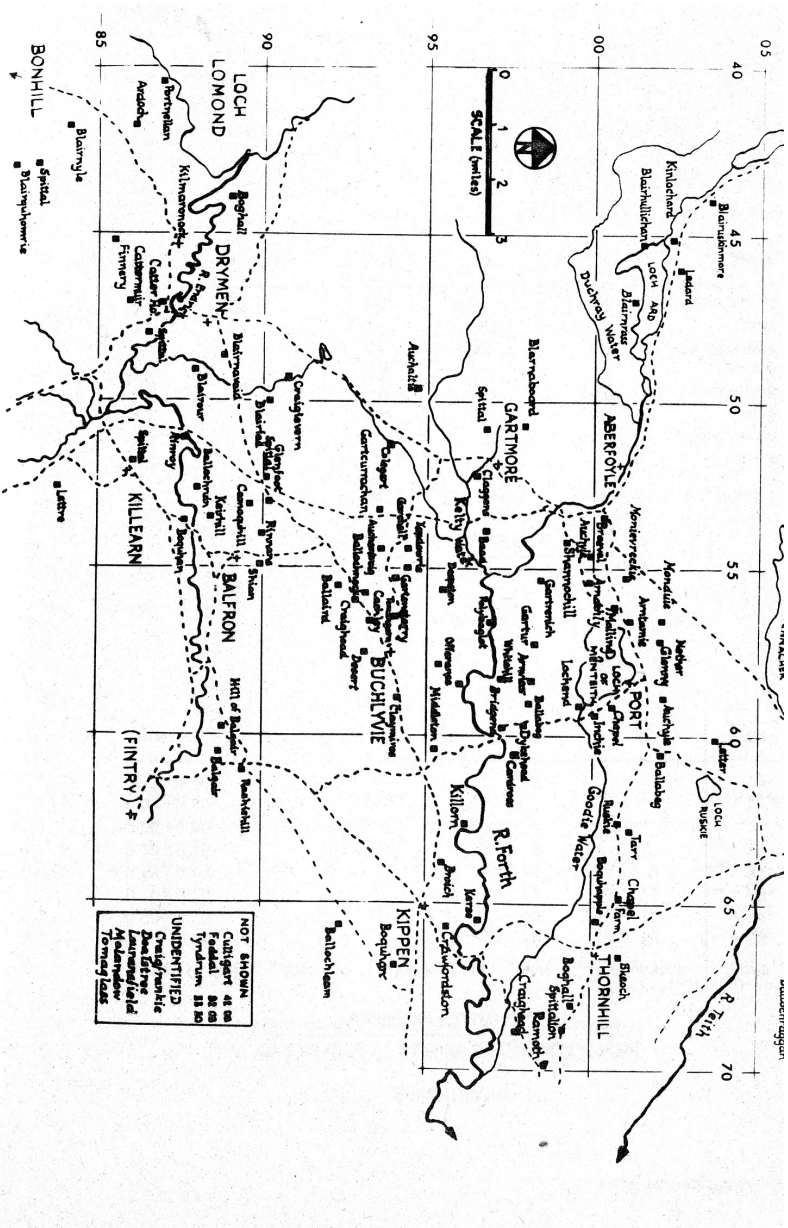
Orientation	Myreton Total	Balquharn		Alva	Tillicoultry
North					Nil
North East	0.7				0.7
East			1.0		1.0
South East	0.4	0.7	4.3	1 .7	7.1
South	1.1	1 .8	5.5	1.6	10.0
South West	1.5	2.4	2.2		6.1
West	2.0		1.4		3.4
North West	1.5		0.4		1.9
Total	7.2	4.9	14.8	3.330.2	

APPENDIX III

The Lengths of Individual Cultivation Terraces

(Number of Occurrences)

Length (Kms.)	Myreton	Balquharn	Alva	Tillicoultry	Total
0.00 -0.05	13	5	9	10	37
0.05 -0.10	33	27	53	11	124
0.10-0.15	21	11	23	12	67
0.15-0.20	6	2	14	2	24
0.20 - 0.25	6		9		15
0.25-0.30					
0.30-0.35					
0.35 - 0.40			2		2
Total	79	45	110	35	26


SCALE (miles)
0 1 2 3
NOT SHOWN
Cultybraggan 46 08
Feddal 82 08
Tyndrum 88 30
UNIDENTIFIED
Craigfranchie
Dunfermline
Laurencefield
Molendinar
Tomeyloss
ABERFOYLE
GARTMORE
BUCHLYVIE
PORT OF MENTEITH
THORNHILL
KILLEARN
BALFRON
DRYMEN
LOCH LOMOND
BONHILL
KIPPEN
R. Forth
R. Teith
Loch Ard
Loch Venachar
Loch Lubnaig
Loch Katrine
Loch Voil
Loch Doine
Loch Vanachan
Loch Achray
Loch Rusky

ON FIRST LOOKING INTO CHAPMAN'S LEDGER

Glimpses of everyday life in the upper Forth valley in the early eighteenth century, revealed by a study of a local tradesman's Credit Sales records.

K.J.H. Mackay

To members of the present generation, it can be very difficult at times to form a detailed picture of life as it was lived in a period before the present, particularly at the level of ordinary people. Even as close as 200 years, one's imagination can hardly comprehend the mode of life of the average inhabitant, let alone the way in which he or she coped with scores of aspects which - by the present time -have evolved into problems demanding nationwide organisation of manufacture and distribution.

Yet from the few truly helpful contemporary local accounts (e.g. Ramsay (1888), OSA (1794)), it is clear that our forebears were capable of Subsisting adequately on what to us might seem an almost entirely local economic system. Even while the towns with their growing industries were voraciously swallowing· the surplus agricultural population displaced by improved or altered farming patterns, manpower requirements on the land were still high by modern standards. Locally at least, innovative ideas were creating new opportunities for expanding cultivation, notably in reclamation schemes either from tidal mudflats or from the 'mosses' blanketing the upper part of the Carse of Forth.

Another local factor which brought about a redistribution, but not a reduction, of the indigenous population, was the effort made by enlightened industrial entrepreneurs to locate their factories in the more salubrious home-grounds of their potential work·force. Fintry, Balfron and Killearn grew at the expense of Buchlyvie, Kippen and Drymen (which had long-established weaving traditions) as well as the scattered rural communities around Aberfoyle, Buchanan and Port of Menteith. Eventually the altruism which sought to avoid gross displacements of local populations could not withstand the economic forces deployed in the competitive battle for survival, and the inevitable depopulation occurred, though delayed possibly by some 50 or 60 years.

Figure 1. Sketch map of upper Forth Valley, indicating probable positions of sites mentioned in ledger.

How did ordinary folk cope with everyday problems in the early 1800s? Without today's weekly or monthly supply of cash, how did they manage to feed and clothe the large - if short-lived - families which we are led to believe were the pattern? Of course, simpler and less sophisticated tastes meant that home produce, whether from the family croft or the family loom, satisfied most of the day-to-day requirements of the typical household.

One is aware of the present tendency to amalgamate holdings of land, leaving a tragic succession of old farms and cotter houses in progressive stages of decay. How can one obtain an acceptable picture of the occupancy pattern at a period when agricultural efficiency required men, not machines? Strangely enough, some answers to these questions emerge from the study of tradesmen's accounts of the time - such as the quaint volume which I have been analysing spasmodically over the past twelve months. In outward appearance, the ledger measures 13cm x 20cm x 5cm, and is covered in a finely-woven, strong, buff-coloured cloth resembling suede leather. This has been crudely stitched on with coarse thread, and includes a linen-lined, button-holed flap which can be bound across with a 60cm long piece of buff tape. Inside, the covers have been stiffened with card cut from a red and blue advertisement of "Gray & Co., Wholesale Merchants, of Glasgow, with works at Adelphi Terrace and Commercial Road". Under the card, the front inside cover has an interesting coloured drawing of a simple farm steading, and an incongruous fleet of 5 assorted sailing ships in the background. The inside back cover is unadorned, but reveals the perishing leather binding of the account book itself. The brown-edged pages within are in good condition for a functional volume of such an age. The writing is well-formed and indeed decorative, even if the spelling is highly individual and vaguely phonetic in character. Each double page is numbered, starting from page 2 and continuing through to page 98. Page 1 is missing, and with it presumably details of the original owner, and any index there may have been to the contents. Seventeen of the right-hand pages are decorated with a regular pattern of 6 thin (1 mm) slices of cork -evidence of the current owner's early interest in the book ... for storing fishing flies. The cork slices do not seriously detract from the available information, as from page 13 onwards, the right-hand page is devoted to the repayment records and has less writing on it. In fact more damage has been done where corks have been removed and have taken part of the succeeding page as well.

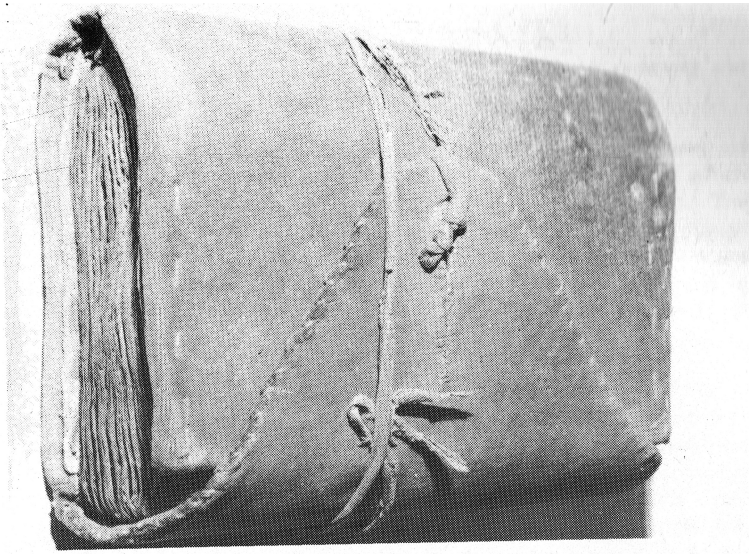


PLATE 5 The Credit Sales Ledger of Mr McEwan, draper, Buchlyvie, for the years 1811-1813.

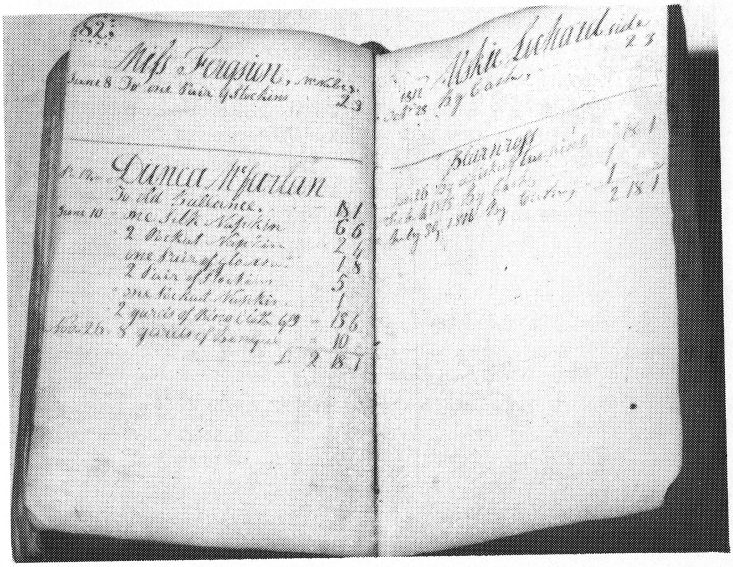


PLATE 6 A typical double page entry in the ledger (page 82).

The book is now in the possession of Mr. William McEwen, of 'Mundalla', Mill Road, Cambusbarron, a member of a family which has farmed Hillhead Farm nearby for several generations. The evidence is that the original owner was of the same surname (though spelt 'McEwan'), the strongest clue being the large cash loans recorded, all to McEwans! The trading base appears to have been in the village of Buchlyvie or neighbourhood, where the majority of customers are concentrated.

The accounts are nearly all for sales of materials or of articles of clothing and the purchasers hail mainly from places within a radius of about 10 miles of Buchlyvie. This seems to point to our tradesman being an itinerant draper. The ledger is not the complete sales record of his transactions, but merely the credit sales record, so it is not possible to reach definite conclusions about his overall clientele. One simply has no clue to the number of cash sales transacted. At the time it was apparently the usual way of doing business in the textile trade to 'Buy now - pay later'. The dealer sold cloth to his customers in, say, April and they did not have to pay for it until October, when he next made his rounds. (McKechnie, 1968) Somehow, I have retained from childhood a mental image of a pedlar or chapman with an usherette-style ice-cream tray of ribbons and tawdry trinkets. Our chapman carried much too large a stock for that, and I am currently debating the merits of (a) a plaided figure leading a panniered pony, (b) a man on horseback leading a pack-animal laden with samples of cloth, and (c) a fully-stocked pony-cart. (There were 285 carts of one kind or another in the parish of Kippen I which included Buchlyvie) in 1794.)

The roads travelled by Mr. McEwan would have been of variable quality. Those in the south were turnpike and of reasonable to excellent standard. In the north, they may have qualified for the general description of Perthshire roads in 1819 as 'a kind of Devil's bowling green' (Southey). I have still no clear picture of just how much of his time was actually spent on rounds. After all, there were at least five ways in which a transaction could take place, resulting in an entry in the ledger:

(1) Customer visits draper's shop in Buchlyvie;
(2) Friend/neighbour takes order to Buchlyvie;
(3) Chance/arranged meeting on round, but away from either party's home;

(4) Draper calls at customer's home;
or (5) Draper calls at friend/neighbour's home, where order has been left.

Coupled with the fact that no details of strictly cash transactions have been recorded, and with the possibility that Mr. McEwan may well have undertaken the occasional tailoring job, there is not really enough evidence to support more than four or five conjectural rounds annually in the two years of the records, 1811 and 1812.

Aberfoyle area	Mid-May 1811
Port of Menteith area	Early June
Balfron area	Mid-June
Aberfoyle area	Mid-November
Aberfoyle area	Early March 1812
Port of Menteith area	Late March
Drymen area	Early May
Aberfoyle & Port of Menteith	Mid-June
Aberfoyle area	Early November

Enough of surmise. What emerges from analysis of the record in other respects? Table 1 is the starting-point for much of this. It lists simply, page by page, the headings of each customer's account, preserving the original (in both senses of the word) spelling as far as possible. Between pages 2 & 98, there are 216 entries of this type, some being carried forward from an earlier entry. A total of 185 customers can be identified.

If we list the customers by surname (Table 2) we arrive at a grand total of 82 different family names, in which the Grahams (16) predominate, closely followed by McFarlanes (15) variously spelt; Buchanans and McEwans tie with 10 each. McGregors, Sands, and Stewarts each muster 6 apiece. (A certain amount of confusion is caused by 9 customers listed without place of residence; of these two can be identified with later entries.) It would be interesting to know whether the same family names predominate today.

One of the most intriguing aspects of the study has been analysis of the 91 place-names listed. Table 3 indicates my attempt to identify these with

locations marked on current Ordnance Survey maps, using map references to indicate the kilometre square in which the site is marked. 74 of the 91 are to be found on modern OS maps. Of these, 9 have names which occur twice or more in the area. Estate records would have to be consulted to clarify these. Another 9 are doubtful identifications, wherethe old and new names do not correspond enough for certainty. A further point of interest is that, of the 74, 70 still appear to have been inhabited at the time of the most recent map survey.

The remaining 17 place-names have provided an excuse for examining any old maps of the area which came my way. Six of them turned up on the 1st Edition Ordnance Survey of 1868, and another 6 on a selection of older maps reaching back to the Blaue compilation of 1654. A tantalising 5 still evade identification. Figure 1 shows in sketch-map form the approximate distribution of the probable locations, except for three which (if correctly identified) lie too far outside the area. For these, one presumes they represent the occasional visitor benefiting from the McEwan willingness to give credit.

The location providing the most customers turns out to be the Offerance, with 15 (including 4 McEwans), while Aberfoyle with 12, and Buchlyvie with 11, are the only others reaching doubte figures. Port of Menteith and Ledard both have 6, Whitehill 5, and Gartur 4. One-third (59) of all his customers are located in 7 centres; the remaining two-thirds (126) are scattered in ones, twos or threes over the other 82 listed locations. Perhaps more than any other statistic, this indicates the significance of the visiting tradesman at that time, in the absence of any regular form of public transport, or of mail order service.

And what of the service provided by Mr. McEwan? Again we are limited to the recorded facts and figures, and cannot speculate on the role of messenger or even purveyor of news, both local and national, for which chapmen of a previous century had become famous. Mr. McEwan was a draper; I am not. So I include, in Table 4, a glossary of appropriate terms culled from the pages of Webster's International Dictionary, with additional information on the local significance of the terms 'bengal', 'blue cloth' and 'drugget' provided by the author of the Old Statistical Account of Killearn parish (Vol.XVI, p.100. 1795).

Analysing the contents of the various entries in the ledger, Table 5 has emerged. A total of 39 fabrics are listed, ranging in price from 4d/yd for the cheapest trimming, to £ 1.3s/yd for the finest 'Blew Cloth'. In the two years of the records, 334 sales were made, and a total of 997 yards sold, quite a prodigious length of cloth. Bengal, cambrice and print were the most frequently requested fabrics (around 40 sales each). Rapper, bombaset, muslin and fustian each brought about 20, while corduroy and shirting were each asked for on 15 occasions. The average length bought would appear to have significance, since this would indicate the probable intended use of the material. (I need some feminine advice here!) In all probability the width of cloth would still be the narrow-loom measure of 27".

Mr. McEwan also retailed articles of ready-made clothing. Table 6 gives the analysis for 314 sales of some 42 different, though related, items. Prices ranged from 6d for a napkin to 2 guineas for a silk shawl. The most popular items were napkins and handkerchiefs (120), followed by stockings (72). Shawls (41), vestpieces - waistcoats (29), and gloves (22) were also good lines. Gallows and breses (14) turn out to be more or less what we call 'braces'!

Combining the income from fabric sales (£103) and that from clothing sales 1£58) Mr. McEwan's turnover" in two years, from credit sales, was £161, or £80 per annum. Assuming a write-up of 50% on wholesale prices, his annual profit would be £27. Making a further assumption that he made as much from cash sales, and we can guess that his business 'salary' was around £55 per year. At a time when agricultural wages were about £10 per year (for a man) and £4 for a woman, Mr. McEwan was probably quite comfortably off.

Glancing through the various customers' accounts, one is from time to time brought up short by an unexpected entry - 'Tea and Shugar 15/2', 'one 800ttel of whiskie 4/0', 'wiving 4'hyds drogat' or 'one young Sow 4/0'. Listing and examining these items as in Tables 7 A and 7B, it will be seen that they fall naturally into two categories - those connected with the business, and those which appear to be sidelines, possibly undertaken as a favour to a particular customer. Indeed, if one also lists the parties concerned, the great majority of the side-line transactions turn out to be for one member of the McEwan family or another .... or to do with whisky! There is an apparent

great difference in the price of whisky from different sources, until one recalls that the Scots pint was equivalent to 3 English pints, and that 1 Scots pint equalled 2 chopings or 4 mutchkins. I calculate the actual variation (per English pint) to be from 1/9d to 3/0, which is neither here nor there as compared with present-day prices! I have not deciphered all the entries here and readers may care to make their own conjectures.

When one member of a family is better off than the others, he tends to be a sitting duck for loan-requests. Our Mr. McEwan is no exception. Table 8 lists some of the cash loans he made during the currency of the ledger. Members of the family benefit to the tune of £59:6:6, while others borrow a mere £2:14:4! As opposed to drapery sales, where accounts may remain unbalanced for years, the loans, at least in the years 1811 - 1813, seem to have been settled within four months, and - in the case of the largest loan of all, £26 - within one month. It is also interesting to see repayment being made in corn, reminding us that cash is merely the token, and that true value resides in transferable commodities.

I'm not sure that I can summarise all this, nor perhaps - if I could - that - should. The more one extracts from this rich vein, the more real the picture becomes. Here certainly are all the ingredients for a Nineteeth Century equivalent of that ever-popular 'every-day story of country folk' except that the setting would be the upper Forth valley and the principal characters would not be Archers, but McEwans.

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Buchanan	Vol IXp12	Aberfoyle	Vol X p 113
Fintry	Vol XI p 371	Kilmaronock	Vol XI p 202
Killearn	Vol XVI p 100	Balfron	Vol XVII p 530
Gargunnock	Vol XVIII p 90	Kippen	Vol XVIII p 317

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EDGAR. J. 1745. Map of Stirlingshire.

MOLL. H. 1726. Mep of Stirlingshire.

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STOBIE. J. 1782. Map of Perthshire.

Table 1. Index to Entries in Mr. McEwan's Credit dales ledger for 1811 – 1813.

Pag	Customer	Location
1	Mr. Grahams Maid	Kippen
	John Graham	Crafortstone
2	Hugh McLachlen (tay1or)	Broch
	John McEwan	Offrance
3	John Mcfarlane (copper)	
	Robert Ferguson (taylor)	
	Dunce Mcdonald	Renans?
	JeanThomas	Blairwhomrie
4	Marey McNaire	Gartur
	May McEwen	Offerance
	Alexr Mcgrigor	
5	Anne McEnnen	Blairfaid
	Allan Kennedy	Buchlyvie
	William McGrigor	Clymire
6	Agnes Carrick	Desart
	Margret McUlly	Kipdourie
	William Galbreth	Glenfoot
7	Margret Shaw	Shiak
	Mrs Mcich	Aberfoil
	Catrine Graham	Ballachrgan
8	Cathran Graham	
	Alexander Graham (carrier)	
	James McEwan	Ramoth
9	Duncan Graham	Blairoulair
	Duncan Mcfarland	Ledard
10	Mrs Mcfarland	Portnellan
	Jannet Carmichel	Portnellan
	Arsl Stewart	Offrance
	Barbra France	Buchlyvie
11	Robert Mcfarland	Letter
	France Sands	Offrance
12	Andrew Morison	Tomacher
	William Mcalpin	Ruskie
	Mrs Junkin	Ruskie

13	David Carrick	Cashley
	George McErracher	Gartur
14	Miss Camron	Miling
	John Thomson	Boghaw
15	Andrew Mcfarland	Buchlyvie
	George Peterson	Sheouch
16	Walter Buchanan	Curroch
	Duncan Mcoal	Currach
17	John Marchal (carrier)	Buchlyvie
	Dunca Mcfarlan	Blarnross
18	Peter Carmichal	Lochend
	Andrew Carrick	Gartenstary
19	Joseph McLuckie	Buchlyvie
	Margret Summers (servant)	Whitehill
20	Daniel Mcoal (tayola)	Port
	Widow Graham	Gleney
21	Cathren Mcallan	Port
	Janet Wright	Port
22	John McQuartan	Shannechal
	Margret Mcgibbon	Monduie
23	Mrs Mcfarlan	Gartronich
	Malkam Mcfarlan	Brovaail
24	Wilm Graham	Gartmore
	Walter Stewart (miller)	Dryman
	David Sands	Arnvicker
25	Marey Sands	Offrance
	Widow Greay	Bowhan
26	Mrs Mackeson	Bowhan
	Mrs Stirling	Courthill
	Peter Nelson	Hill of Balgair
27	Mrs Leany (miller)	Bogair
	William McEwan (miller)	
28	George McEarrecher	Gartur
	Agness McNair	Gartur
29	Moses Mcadam	Blairfaid
	Alxender Mcgrigor	Craigvair

30	Mrs Gearner Agness McLean (servant)	
31	Marrand Buchanan	Uttrance
32	Marey McLoud Walter Thomas	Aberfoil Blairwhomrie
33	Margret Lennox Marey Mcgibbon	Cotter Blairnil
34	Agness McNeil Arsbala Graham	Lochardside Aberfoil
36	Cathren Mcfarland Andrew Morison	Aberfoil Tomachar
36	Archd Fergison Donald Fesher William Sand	Louransfield Ruskie Whitehill
37	James Wood John Shirra	Polablagan Cheepel
38	James Jack Salley Mcferson	Ester Feaddel Tomaglass
39	John Risk Mrs Mcfarland	Du..ton Kipdowrie
40	Mrs McNee	Bolabeg
41	Mery Mctavish John Mcfarland	Tomachar Monduie
42	John Macklom (wright) Jean McLachlen	Gartmore Gartmore
43	James Wood Andrew Ore	Polablagan Skiaak
44	Mery McLuckie Bell Servant	Offrance Lyadrd
45	Duncan Graham	Blarolachan
46	Cathren Mcgrigor Alexr McLeran	Blarolachan Lydard
47	Margret Livenstone John Mcfarlane	Lydard Cullagert

48	Andrew Stewart (wevar) George Mcfarlane	Aberfoil Blarnabit
49	John McQuartan	Shenlloch
50	Walter Mcfeat Margret Me Lew	Bad Tomaglass
51	Agness Carrick Miss Graham	Buchlyvie Molandow
52	Robert Buchanan Peter Mcgrigor	Rinroy Clyairmire
53	Jannet Drummond Mery McNair	Gartur
54	Mrs McEwan	Off ranee
55	Hugh Camron James Mcouat	Gartur Rashill
56	Elizabeth McEwan	Offrance
57	John McEwan	Offrance
58	Jean Sands John Buchanan	Deykhead Offrance
59	Thomas McEwen	Bolard
60	Bell, George Jannet Carmichal	Whitehill Portnellan
61	Margret McLean Andrew Mcfarlan	Portnelan Buchlyvie
62	Mary McLean William Buchanan	Offrance Cardross
63	Aberfoyle Smith Peter McKich	Aberfoyle
64	Donald Mcfartand	Lydard
65	John Graham Bell, Graham	Blaruskan Aberfoyl
66	Donald Camron James McEwan	Bridgend Tynedrum

67	Christean Leany	Tomaglass
	Margret Mculley	Kipedourle
68	Cathren Graham	Offrance
	Meary Sands	Offrance
69	Thomas Mcallan (wever)	Port
70	Robert Mcfarlan	Letter
	Arsbald Fergison	Louransfield
71	Robert Fergison	Deykhead
	George Graham	Ruskie
72	James McEarthur	Tarr
	Widow Gray	Ballachlem
73	Andrew McEwan	Bogair
	Anney McEnnan	Bloirfad
74	Alexr McGrigor	Craigvern
75	Alexr Gearner	Finnery
	Agness Gray	Offrance
76	John Mcgrigor	Finnery
	James Nelson	Renans
77	Bardra Freanc	Buchlyvie
	Jannet McNea	Polabglan
78	Francie Sands	Offrance
	William Mcouat	Whinehill
79	Walter Thomas	Blairwhomrie
80	Robert Stewart	Cashley
	James Miller	Troig
	Andrew Stewart	Dreyman Mill
81	Mary Mcalpen	Spittle
	Jannet McKinsie	Lochardside
82	Miss Fergsion	Lochardside
	Dunca Mcfarlan	Blarnross
83	Robert Monnoch	Arnechley
	Jannet Fisher	Monduie
	John McNab (shooemaker)	Port

84	John Wtight	Port
	Mr Archd Leil	Aucheuil
	Robert Shirra	Boquhapple
85	James Jack (farmer)	Feaddel
	Moses Mcgibbon	Whitehill
	John Buchanan (carrier)	Aberfoil
86		
	Margret Mcfarlane	Aberfoyil
	John Mcfarland	
	James McLuckie	Auchaltie
		Ballacneck
87	Moses Mcadam	Blairfad
	Revd Mr Murdock	Kilmaronock
	Jannet McLintock	Kilmaronock
88	Eleziabeth Buchanan	Kilmaronock
	Miss Duncan	Bunhill
	Aanne McLay	Cammechal
89	Jannet Gray	Offrance
	Francie Sands	Off ranee
90	Mrs France, widow	Buchlyvie
	Mrs McLuckie, widow (carrier)	Buchlyvie
91	Agness Carrick	Dessert
	Margret Stewart	Dealstree
	Alexander Mcalester (shoeomaker)	Buchlyvie
92	Andrew Wood	Clagan Mill
	George Mitchell	Polabeglan
	Meary McLearen (servant)	Ledard
93	Margret Livinstown	Ledard
	Peter McEkeich (labourer)	Aberfoil
	Arsbald Buchanan	Inchrey
94	John McEvie (maltman)	Aberfoil
	Christian Mclntyr	Aberfoil
	Duncan Mcarther	Craigfrankle
95	William McGrigor	Clymire
	Wallter Stewart	Drymot
	William Glbraith	Glenfoot
96	Barbra Buchanan	Offrance
	Anne Sands	Arnvicker
	Alexaner McLearen	Middeltown

97	Miss Margret Graham	Glenney
	Christian Buchanan	Offrancan
	Christian Graham	Craigeheed
	Thomas McLean	Cardross
98	John Forsyth (weaver)	Kelliearn
	John McLew	Camechal
	Miss France	Buchlyvie
	Mrs Fergsion	Manvriche
	Alexander Leanny	Garchel
	Alexr Montgomerie	Thornhill

TABLE 2 Analysis, by surname and place of residence, of customers listed in ledger

Location of Customers, with Page References

Buchanan	Aberfoyle-85, Curroch-16, Cardross-62, lnchrey-93, Kilmaronock-88, Offrance-31, 58, 96, 97, Rinroy-52.
Camron	Bridgend-66, Gartur-55, Miling-14.
Carmichal	Lochend-18, Portnellen-10, 60.
Carrick	Buchlyvie-51, Cashley-13, Deasart-6, 91, Gartinstary-19.
Duncan	Bunhill-88.
Fergison	Dykehead-71, Lochardside-82, Louransfield-36, 70, Manvricke-98
Fisher	Monduie-83, Ruskie-36.
Forsyth	Kelliearn-98.
France	Buchlyvie-10, 77, 90, 98.
Galbreth	Glenfoot-6,95.
Gearner	Finnery-30,75.
George	Whitehill-60.
Graham	Aberfoil-34, 65, Ballachrgan-7, Blaru'skin-65, Blairoular-9, Blarola-chan-45, Crafortstone-1, Craighead-97, Gartmore-24, Glenny-20, 97, Kippan-1, Molandow-51, Offrance-68, Ruskie-71.
Gray	Ballochleam-72, Bowhan-25, Offrance-75, 89.
Jack	Feddal-38,85.
Junkin	Ruskie-12.
Kennedy	Buchlyvie-5.
Leany	Balgair-27, Garchell-98, Tomaglass-67.
Leil	Auchyle-84.
Lennox	Catter-33.
Livenstone	Ledard 47, 93.
McAdam	Blairfad-29,87.

McAlester	Buchlyvie-91.
McAllan	Port-21,69.
McAlpin	Ruskie-12, Spittal-81.
McArthur	Craigfrankie-94, Tarr-72.
McDonald	Renans-3.
McEnnan	Blairfad-5,73.
McErracher	Gartur-13, 28.
McEvie	Aberfoil-94.
McEwan	Balgair-27, 73, Ballaird-59, Offerance-2, 4, 54, 56, 57, Ramoth-8, Tyndrum-66.
McFarlane	Aberfoil-35, 86, Auchaltie-86, Blarnabit48, Blarnross-17, 82, Braeval-23, Cullagert-47, Gartrenich-23, Kepdowrie-39, Ledard-9, 64, Letter-11, 70, Monduie-41, Portnellan-10.
McFeat	Baad-50.
McGibbon	Blairnyle-33, Monduie-22, Whitehill-85.
McGrigor	Blarolachan-46, Claymires-5, 52, 95, Craigievern-29, 74, Finnery-76.
Mclntyre	Aberfoyle-94.
McKinsie	Lochardside-81.
Mackeson	Bowfian-26.
McKich	Aberfoil-7, 63, 93.
Macklom	Gartmore-42.
McLachlan	Broich-2, Gartmore-42.
McLaren	Ledard 46, 92, Middleton-96.
McLay	Camoquhill-88.
McLean	Portnellan-61, Cardross-97, Offerance-62.
McLew	Camoquhill-98, Tomaglass-50.
McLintock	Kilmaronock-87.
McLuckie	Ballacneck-86, Buchlyvie-19, 90, Offerance-44.
McNab	Port-83
McNair	Gartur-4, 28, 53.
McNea	Ballabeg-40, Polabaglan-77.
McNeil	Lochardside-34.
McOal	Currach-16, Port-20.
McOuat	Rashiehill-55, Whitehill-78.
McPherson	Tomaglass-38.
McQuartan	Shannochill-22,49.
McTavish	Tomachar-41.

McUlly	Kepdowrie-6,67.
Marchal	Buchlyvie-17.
Millar	Troig-80.
Mitchell	Polabaglan-92.
Monnoch	Arnechley-83.
Montgomerie	Thornhill-98.
Morison	Tomachar-12,35.
Murdock	Kilmaronock-87.
Nelson	Hill of Balgair-26, Renans-76.
Ore	Skiaak-43.
Peterson	Sheouch-15.
Risk	Dunston-39.
Sands	Arnvicker-24, 96, Dykehead-58, Offerance-11, 25, 68, 78, 89, Whitehill-36.
Servant	Ledard-44.
Shaw	Shiak-7.
Shirra	Boquhapple-84, Chapel-37.
Smith	Aberfoyle-63.
Stewart	Aberfoil 48, Cashley-80, Dealstree-91, Drymen-24, 80, 95, Offerance-10.
Stirling	Courthill-26.
Summers	Whitehill-19.
Thomas	Blairwhomrie-3, 32, 79.
Thomson	Boghall-14.
Wood	Clagan Mill-92, Polabaglan-37, 43.
Wright	Port-21,84.

TABLE 3 Listing of locations mentioned in ledger, giving probable map references to nearest kilometre, and families resident

Possible Identification

Location	1"OS (1957)	Map Ref	Other Source	Customers Resident
Aberfoil	52 00			Buchanan, Graham. McEvie, Mcfarlan, Mclntyr, McKich, McLoud, Smith, Stewart
Arnechley	-	5599	2%" OS (1956)	Monnoch
Arnvicker	Arnvicar	5898		Sands
Auchaltie	-	5094	1"OS(1868)	Mcfarland
Auchiel	Auchyle	5901 5400	1" OS (1868)	Leil
Bed	Baad	5396		McFeat
Ballachlem	Ballochleam	6592		Gray
Ballacneck	Ballochneck	5593		McLuckie
Ballachrgan	Ballochruin Ballochrag-gan	588 6706		Graham
Blairfaid	Blairfad	5090		McAdam, McEnnan
Blairoulair	Blairour	4987		Graham
Blairwhomrie	Blairquhomrie	4382		Thomas
Blarnabit	Blarnavaid Blarnaboard	4888 5097		Mcfarlane

Blarnil	Blairnyle	41 83		McGibbon
Blarnross	-	4601	Edgar (1745)	Mcfarlan
Blarolachan	Blairhullichan	4401		Graham, Mcgrigor
Blarusken	Blairuskinmore	4303		Fergsion, Graham
Bogair	(Balgair Mill)	6088	1" OS (1868)	Leany, McEwran
Boghaw	Boghall (Boghowe)	4389 6899	Edgar (1745)	Thomson
Bolabeg	Ballabeg Ballabeg	6002 5998		McNea
Bolard	Ballaird	5592		McEwen
Boquhapple	Boquhapple	6500		Shirra
Bowhan	Boquhan Boquhan	5387 6794		Greay, Mackeson
Bndgen	---------- Bridgend	5997 5398	Stobie(1787) 2½OS (1956)	Camron
Broch	(Bruich)	6395	Moll (1725)	McLachlan
Brovaail	Braeval	5300		McFarlan
Buchlyvie	Buchlyvie	5793		Carrick, France, Kennedy, Mcalester, Mcfarland, McLuckie, Marchal.

Bunhill	Bonhill	3979		Duncan
Cammechal	Camoquhill	5389		McLay, McLew
Cardross	Cardross	6097		Buchanan, McLean
Cashley	Cash ley	5693		Carrick, Stewart
Cotter	Cattermuir	4686		Lennox
Cheapel	(Chapel Farm) (Chapel)	6500 5900	6" OS (1923) 1" OS (1868)	Shirre
Clagan Mill	(Claggan)	5296	1"OS(1868)	Wood
Clymire	Claymires	5994		Mcgrigor
Courthill	(Keirhill ?) (Court hill, Catter)	5388 4787	2½OS (1956) OS A XI p202 (1794)	Stirling
Crafortstone	(Crawfordston)	6595	2½OS (1956)	Graham
Craigfrankie	-	?		Mcarthur
Craigehead	(Craighead) Craighead	5592 6998	2½OS (1956)	Graham
Craigvair(n)	Craigievern	4991		Mcgrigor
Cullagert	(Colegart) Culligart	5194 4208	1" OS (1868)	Mcfarlene

Currach	Gartcurrachan ?	5393		Buchanan, Mcoal
Dealstree	-	?		Stewart
Deasert	(Desert)	5692	1" OS (1868)	Carrick
Du..ton	(Dunston)	5793		(R)isk
Drey man	Dry men	4788 5195	1" OS (1956)	Stewart
Deykheed	Dykeheed	5997		Fergison, Sands
(Ester) Feddal	Feddal	8208		Jack
Finery	Finnery	4484		Gearner, Mcgrigor
Garchel	Garchell	5494		Leanny
Gartenstary	Gartinstarry	5593		Carrick
Gartmore	Gartmore	5297		Graham, Macklom, McLachlen
Gartronich	Gartrenich	5598		Mcfarlan
Gartur	Gartur	5798		Camron, McErracher, McNair
Gleney	Nether Glenny	5701		Graham
Glenfoot	Glenfoot	5390		Galbreth
Hill of Balgair	Hill of Balgair	5989		Nelson
Inchrey	Inchie ?	5900		Buchanan

Kipdourie	Kepdowrie	5594		Mcfarland, McUlly
Kelliearn	Killearn (Killorn)	5286 6296	21/4"OS (1956)	Forsyth
Kilmaronock	Kilmaronock	4587		Buchanan, McLintock, Rev. Murdock
Kippan	Kippen	6494		Graham
Lydard	Ledard	4602		Livenstone, Mcfarland, McLeran, Servant
Letter	Letter	6003		Mcfarland
	Lettre	5283		
Lochardside	Kinlochard ?	4502		McKinsie, McNeil
Lochend	Lochend	5999		Carmichal
Louransfield	-	?		Fergison
Manvriche	(Monievreckie)	5501	1" OS (1868)	Fergsion
Middeltown	Middleton	6095		McLeeren
Miling	Mailing	5600		Camron
Molandow	-	7		Graham
Monduie	(Mondury)	5601	Edgar (1745)	Fisher, Mcfarland, Mcgibbon

Offerance	Offerance	5895		Buchanan, Graham, Gray McEwan, McLuckie, Sands, Stewart
Polabeglan	(Polybaglot)	5697	2½ OS (1956)	McNea, Mitchell, Wood
Port	Port of Menteith	5801		Meal Ian, McNab, Mccoal, Wright
Portnellan	Portnellen	4086		Carmichal, Mcfarland, McLean
Ramoth	(Ramoth)	7098	6" OS (1923)	McEwan
Rashill	Rashiehill	61 89		Mcouat
Renans	Rinnans	5489		Mcdonald, Nelson
Rinroy	(Ronroy)	5087	Blaue (1654)	Buchanan
Ruskie	Ruskie	6200		Fesher, Graham, Junkin, Mcalpin
Shannechal Shanlloch	Shannochill	5499		McQuartan
Shiak, Skiaak, Sheouch	(Skeoch) Shian	6600 5589	6" OS (1923)	Ore. Peterson, Shaw
Spittle	Spittalton Spinal Ballat Spittal Spittal Spittal Spinal	6399 5290 5286 5097 4786 4383		Mcalpen

Tarr	Easter Tarr	6300		McEarthur
Thornhill	Thornhill	6699		Montgomerie
Tomachar	(Tomagarn)	5693	2½ OS (1956)	Mctavish, Morison
Tomaglass	-----	????		Leany, Mcferson, McLew
Troig	Auchentroig ?	5493		Miller
Tynedrum	Tyndrum	3330		McEwan
Whitehill	Whitehill	5897		Bell, Mcgibbon, Mcouat, Sand, Summers

TABLE 4 Glossary of 26 of fabric materials listed in ledger

Material	Description
Bengal	A silk or striped cotton woven in Bengal; imitation of such; (locally) a cloth of linen warp and cotton weft.
Blue Cloth	Finely woven woollen cloth used for men's best clothes. Also known as Scots cloth, and dyed brown, blue or grey.
Bombazine	A silk fabric in twill weave, dyed black for mourning wear; a twilled fabric with silk warp and worsted filling, variously dyed.
Calico	A plain cotton fabric heavier than muslin; may have figure patterns.
Cambric	A fine thin closely woven plain white linen fabric; a cotton fabric resembling cambric, usually white or piece-dyed, with glossy or glazed finish.
Chambray	Light-weight clothing fabric of plain weave (cotton/silk/linen); (Shambery) frosted appearance due to interweaving of coloured warp, and white filling yarns.
Check	Fabric woven or printed with pattern in squares.
Corduroy	A cut-pile fabric with vertical ribs usually made of cotton in plain or twill weave, and in various weights.
Crape	A thin worsted stuff used for clerical gowns etc.
Dimity	A sheer cotton fabric of plain weave, usually checked or striped by corded effects made by weaving two or more threads as one.
Drugget	Fabric of wool, or wool and linen used for clothing; (locally) material with linen warp and woollen weft.
Duffle	Coarse heavy woollen blanketing.
Flannel	A soft twilled fabric with loose texture and slightly napped surface, in various weights of wool or worsted yarns, often in combination with cotton yarns.
Fustian	A strong cotton and linen fabric; a class of cotton fabrics usually having a pile face and twill weave.
Gauze	A loosely woven cotton fabric.
Gingham	Clothing fabric in yarn-dyed cotton in plain weave, made in bold colours, checks, plaids and stripes.
Lace	A fine open-worked patterned fabric.
Lawn(Land)	A sheer plain-woven cotton or linen fabric, given various finishes.
Muslin	Plain-woven cotton fabric of various qualities from sheer to coarse used bleached or unbleached for sheeting or embroidery.
Nankeen	A firm twilled cotton fabric usually dyed to a yellow colour.
Plush	Fabric with long even pile; less dense than velvet; made on a cotton ground, with pile of silk or cotton.

Print	Cloth, usually cotton, with a patterned or figured design.
Serge	A twilled durable fabric having a smooth clean face with a pronounced diagonal rib on front and back; in various weights.
Shirting	Any fabric suitable for men's shirts.
Swandown	Trimming on article of dress from soft downy feathers of swan; a heavy cotton flannel, with thick nap on face, made with sateen weave.
Velveteen	Cotton fabric with plain or twill weave and short close weft pile in imitation of velvet.

TABLE 5 Analysis of credit sales of Materials listed in ledger (1811-1813)

Material	Price-range/yd	No of Sales	Total yds Sold	Average	Total Sales
Bengal	1/1 - 1/11	42	139½	3.4	8/17/4
Blue Cloth	6/6 - 23/0	7	16	2.3	7/16/6
Bombesat	1/5 - 2/0	20	110	5.5	10/5/9
Buttons (doz.)	5/0 - 8/0				
Callico	0/10	2	2½	1.25	2/1
Cambrice	1/3½ - 3/4	38	75	2.0	10/4/1
Spotted Cam	2/8 - 3/0	2	1¼	0.6	3/6
Check	2/4	1	¼	0.5	1/2
Cordroy	2/6 - 4/0	15	43	2.9	7/2/3
Demeity	1/2 - 1/8	10	37	3.7	2/10/7
Duffel	6/0 - 12/0	4	10	2.5	5/6/0
Flannel	1/6 - 1/8	4	7½	1.9	11/7
Fusting	1/2 - 1/6	18	39½	2.2	2/14/10
Gaws	0/9 - 3/0	5	3¼	0.6	6/9
Gingham	1/0 - 1/4½	10	37	3.7	1/6/2
Greay Cloht	4/6 - 5/0	3	11½	3.8	2/11/9
Lace	6/0 - 4/0	5	9½	1.9	11/4
Linen Cam	10/6 - 13/0	2	1¼	0.6	12/4
Marine Crape	4/4	1	6	6.0	1/6/0
Musling	0/11 - 2/0	19	37½	2.0	2/11/7
Land Musling	1/10 - 2/0	11	7	0.6	13/4
Spotted Musling	3/6	1	1½	1.5	5/3
Twelled Musling	1/2	1	1	1.0	1/2
Nankeen	1/0 - 1/7	2	8	4.0	10/0
Plush	8/0 - 12/0	6	9	1.5	4/4/1
Print	1/3 - 2/6	35	170	4.9	15/19/5

Blue Print		1/8	2	10	5.0	16/8
Buff Print		1/6	1	3	3.0	4/6
Light Print		1/10	1	6	6.0	11/0
Rapper (muslin?)	0/7 -	1/0	21	47½	2.2	2/4/7
Serge	1/3 -	1/6	4	9½	2.4	12/11
Hair Serge		8/8	1	1½	1.5	13/0
Twilled Serge		1/4	1	2	2.0	2/8
Shambery	1/2 -	1/4	11	57	6.2	3/9/7
Shirting	1/3 -	2/0	14	53	3.7	4/7/4
Stripped Ten		1/8	1	2¼	2.2	3/9
Swandown		4/0	1	1¼	1.2	5/0
Tartan	1/1½ -	1/4	4	8½	2.1	1/2/2
Thread (per lb)	0/4 -	4/8	2			
Trimming		3/10	4	4	1.3	5/6
Velveteen	3/10 -	4/4	3	8	2.7	1/8/10
Totals			334	997		**£103/2/4**

TABLE 6. Analysis of credit sales of Clothing Items listed in ledger (1811-1813)

Item	Price-range	No. of sales	Total Sales
Breeches (Cordroy)	8/0	1	8/0
Breses	17 0	1	1/0
Comfort	2/0-2/3	2	4/ 3
Duffel (Read)	£1/7/0	1	1/7/0
Gallows	0/6- 1/4	13	13/2
Gloves	1/3- 11 0	21	1/15/9
Silk Gloves	4/6	1	4/6
Hankerchs	0/8-2/0	22	1/3/ 1
Napkins	0/6-2/6	65	4/ 1/ 1
Red Napkins	2/0-2/8	9	1/ 1/ 1
Turkey Red Napkins	2/0-2/6	5	12/0
Black Napkins	21 0	1	2/0
Half Napkin	1/3- 31 3	3	7/8
Silk Napkins	5/4-9/6	15	5/4/11
Night Cap(e)	1/2- 1/3	4	4/10
Plaid	14/0	1	14/ 0
Rob(e/ Piece	9/0	1	9/0
Shawl	3/0 -10/6	6	1/11/6
Printed Shawl	1/8-3/4	2	5/ 0
Black Shawl	4/6	1	4/ 6
Black and White Shawl	4/3	1	4/ 3
Half-shawl	2/9	1	2/9
Immitation Shawl	4/0 -14/6	15	6/4/8
Murning Shawl	4/6-5/9	4	1/ 1/ 1
Red Shawl	6/0	1	6/0
Silk Shawl	£2/0 - £2/2	5	10/4/0
Silk and Cotton Shawl	14/6 -£1/1	3	2/11/ 0
Worstel Shawl	4/10 -5/0	2	9/10
Spats	I/9- 21 9	2	4/6
Stockings —Black	2/0-3/6	63	7/14/6
Drab	21 4	1	2/4
Green	21 0	1	2/0
Grey	21 6	1	2/6
Pure White	2/6-2/8	2	5/2
Lambs wool	2/6-3/6	3	8/6
Women's	2/10	1	2/10
Stuffer	6	2	1/0
Stuffer and Napkin	1/10	1	1/10
Vest piece	2/0-5/6	23	4/18/4
Plush Vest-piece	10/0-10/9	3	1/10/9
Mosile Vest-piece	4/9	2	9/6
Red Shag Vest-piece	11/0	1	11/ 0
		314	**£58/12/8**

TABLE 7A Lists of payments for services linked to drapery business

Payment for services linked to Business

TABLE 7B. Lists of payments for items unconnected with drapery business.

Breachen and Seadle & Coll (Britchin, Saddle & Collar)	£1/10/ 0	John McEwan (Offerance)
Sweine	1/ 4/ 0	John McEwan (Offerance)
Files and Rispes	3/ 0	James McEwan (Ramoth)
Cash for a wach	2/ 0	William McEwan, miller
5 pekes and 5 Ibs meal		William McEwan, miller
Tea and Shugar	15/ 2	William McEwan, miller
gallons whiskey (@ 14/ 6)	2/ 3/ 6	Dunca Mcfarlan (Blarnross)
7 gilles of whiskey	2/11	Daniel Mcoal (Port)
gilles of whiskie	1/10	Daniel Mcoal (Port)
one pint one choping (?)	15/ 0	William McEwan, miller
one Boottel of whiskie	4/ 0	John McEwan (Offerance)
whiskiey two pints	18/ 1	Dunca Mcfarlan (Blarnross)
two pints and one muchkin whiskie	10/ 1/ 4	Mrs. France, widow (Buchlyvie)
Cash for Honney	1/ 1/ 0	Walter Thomas (Blairwhomrie)
one knife @ Servant (?)	1/ 0	John Mcfarlane (Cullagert)
one Press	18/ 0	Jannet Drummond
one young Sow	4/ 0	John McEwan (Offerance)
5 Seeks	8/ 0	John McEwan (Offerance)
for a looking & white iron	10/ 0	John McEwan (Offerance)
Ballance for a bull	1/ 0/ 0	John McEwan (Offerance)
Corn (amount unstated)	21/ 0/ 0	John McEwan (Offerance)
Money for settes (?)	3/ 9	Thomas McEwan (Ballaird)
Sheep in part	3/10/ 0	Thomas McEwan (Ballaird)
Goods of different kinds	18/ 4	Arc^{d} Lei' (Aucheil

TABLE 8. Catalogue of Cashloans made to relatives and favoured customers.

Amount	Date of Loan	Recipient	Date Repaid
£1/7/0	10. 1.1811	John McEwan (Offerance) before	6.12.1811
3/ 0/ 0	2. 2.1811	John McEwan (Offerance) before	6.12.1811
17 2/ 0	28. 5.1811	May McEwan (Offerance) before	6.12.1811
4/ 0	24. 6.1811	May McEwan (Offerance) before	6.12.1811
11/ 0	15. 7.1811	John McEwan (Offerance) before	6.12.1811
1/ 0	22. 7.1811	Arsbala Graham (Aberfoil)	16.11.1811
2/ 0	18.11.1811	Walter Thomas (Blairwhomrie)	10.12.1811
5/ 0	12.12.1811	Mrs McEwan (Offerance)	18.02.1812
12/ 0	16. 1.1812	James McEwan (Ramoth) part	22.03.1813
3/ 0	28. 2.1812	William Sand (Whitehill)	18.06.1812
1/ 1/ 0	4. 3.1812	James Wood (Polablagan)	21.05.1812
26/ 0/ 0	27. 3.1812	William McEwan, miller	24.04.1812
10/ 0	12. 7.1812	Moses McGibbon (Whitehill)	23.11.1812
27 0	24. 8.1812	James McEwan (Ramoth)	
7/ 6/ 0	18.11.1812	John McEwan (Offerance) in corn	10.03.1813
3/ 0	16. 1.1813	William Buchanan (Cardross)	
17/ 0/ 0	16. 1.1813	John McEwan (Offerance) in corn (part)	10.03.1813
6/ 0	15. 2.1813	Mrs McEwan (Offerance)	
2/ 0	12. 3.1813	Mrs McEwan (Offerance)	
1/ 0/ 0	27. 3.1813	John McEwan (Offerance)	
8/ 0	14. 5.1813	John McEwan (Offerance)	
9	9. 4.1814	Andrew Ore (Skiaak)	
2/ 6	23. 6.1814	Mrs France, Widow (Buchlyvie)	10.9.1814
1/ 6	27. 6.1814	Mrs McEwan (Offerance)	
5/ 7	29. 6.1814	Mrs France, Widow (Buchlyvie)	
5/ 6	9. 8.1814	Mrs France, Widow (Buchlyvie)	
£62/ 0/10			

POST SCRIPT: I recently paid a visit to the kirkyard of Buchlyvie's old North Church (1751). The first memorial which caught my eye was set in the wall to the left of the gateway as I entered. It read "MDCCCXXVI. JOHN McEWAN, Merchant in Buchlyvie". No date of death, just the year 1826. Most surprising of all, in a carved panel above was a man's head in profile, smoking a pipe! Amazing if this should indeed be our itinerant draper!

FORTH NATURALIST AND HISTORIAN

TITLE

The title of the paper should be kept as short as possible.

TEXT

Manuscripts should be typed (double-spaced) on one side of the paper, leaving ample margins, with the folios numbered. Words to be printed in italic should be underlined.

The style should be designed to appeal to the educated layman/sixth year studies student, without sacrifice of scientific content. Manuscripts should be as concise as possible.

All linear measurements and weights should be in the metric scale. International abbreviations should be used, e.g. g (gram), kg (kilogram), h (hours), min (minutes).

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Tables should be set out on separate sheets numbered in Arabic numerals, and given a concise heading.

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