

Archaeological and palynological investigations on the Antonine Wall near Glasgow Bridge, Kirkintilloch

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ABSTRACT

This paper presents details of an archaeological excavation conducted across the line of the Antonine Wall in 1992, in advance of pipeline construction, and of a palynological study of the organic fills present within the Antonine Ditch. The palynological study and radiocarbon dating have documented an important vegetation and land-use sequence for this part of Central Scotland over the 500–600 years following the construction of the Antonine frontier. The results are evaluated in light of previous studies relevant to this area. The work was funded by Central Scotland Water Development Board, through Crouch Hogg Waterman.

THE EXCAVATION

In October 1992 a two-week excavation was undertaken by the Centre for Field Archaeology (CFA) across the line of the Antonine Wall and associated frontier works near Glasgow Bridge, Kirkintilloch (NGR: NS 6274 7284; illus 1). The excavation was conducted on behalf of Central Scotland Water Development Board, in advance of the construction of a water pipeline. Following the excavation, the pipeline was to be inserted through the excavated area in order to avoid damage to the adjacent archaeological deposits.

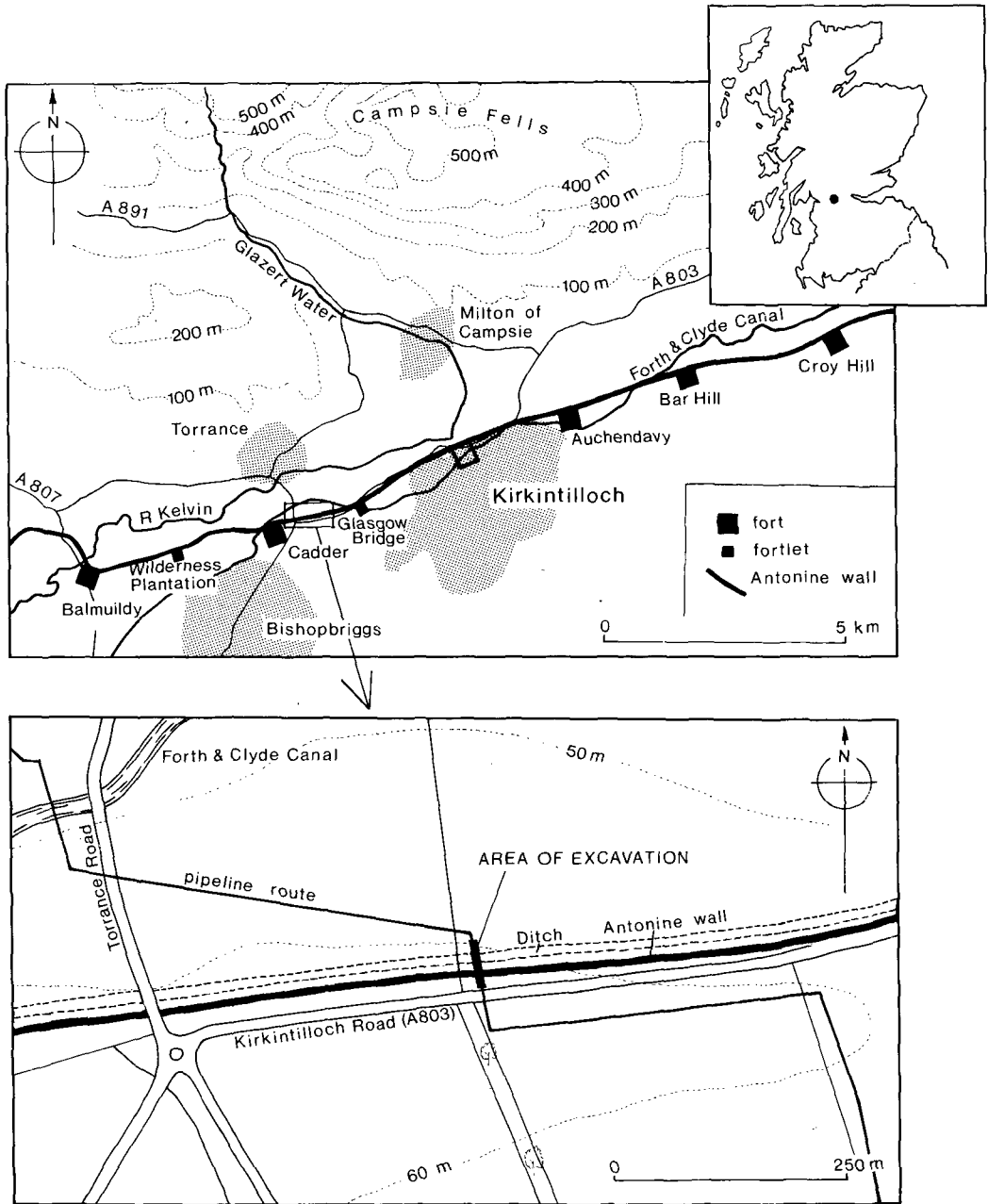
BACKGROUND

The excavation was conducted at a point where the Antonine Wall crosses currently arable land on the southern side of the Kelvin Valley, west of Kirkintilloch, on a moderately steep slope with extensive views northwards across the valley towards the Campsie Fells (illus 2). The point of excavation lies roughly midway between (and c 1 km from) the fort at Cadder to the west and the fortlet at Glasgow Bridge to the east. No Roman garrison points or minor enclosures have yet been identified between Cadder and Glasgow Bridge, although relatively little previous excavation work has occurred here (see Keppie 1974; Robertson 1990), and nowhere in this sector do the frontier works survive above ground in a coherent manner.

Eighteenth-century antiquarian accounts indicate that the course of the Ditch was then for the most part clearly visible between Cadder and Kirkintilloch (eg Gordon 1726; Horsley 1732; Roy 1793). None of these sources mentions the Rampart, suggesting perhaps that no coherent

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ILLUS 1 Site location maps. (Based on the Ordnance Survey map © Crown copyright)

upstanding trace of this feature survived. Stuart's (1852, 322) more recent account indicates further degradation of the surface remains, recording that the course of the frontier in this area was almost entirely obliterated, with the Ditch only occasionally recognizable as a slight depression in cultivated fields.



ILLUS 2 General view showing Rampart and Ditch under excavation, with the Campsie Fells to the north-east

Currently the course of the Ditch can be seen reflected as dips in field boundaries (Macdonald 1934, 154; Robertson 1990, 81), although a faint, shallow and wide depression could be discerned marking its position at the point of excavation. No other surface remains of the frontier works are evident. The Military Way is believed to follow the same course as the current A803 road along the brow of the slope (Robertson 1990, 81; fig 1). Horsley (1732, 158) mentioned that the Military Way, which was then still clearly visible in several places, had been incorporated into the main route from Cadder to Kirkintilloch.

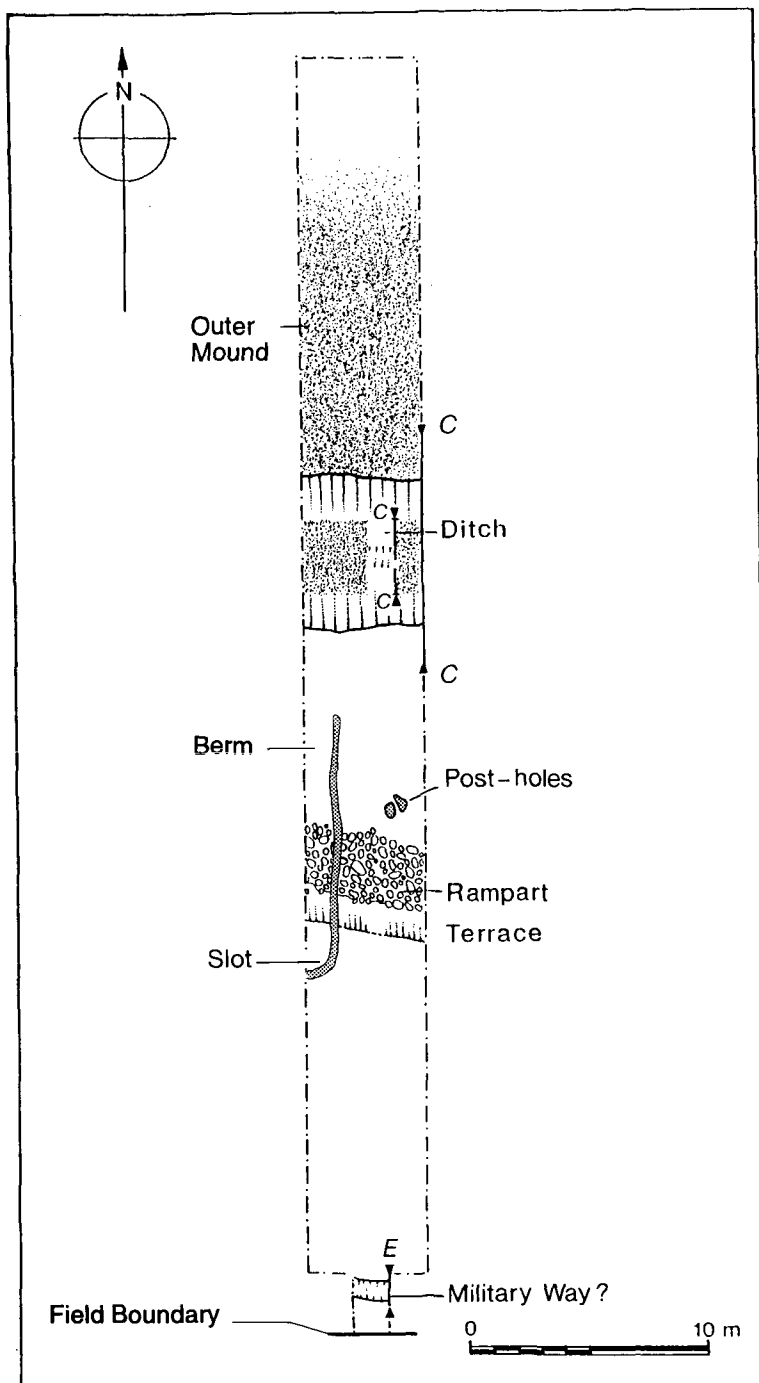
The area of excavation lay on imperfectly drained till derived from carboniferous shales, sandstones, limestones and cementstones. This is underlain by a solid geology consisting of Upper Carboniferous Clackmannan Group limestone (Geological Survey of Great Britain 1992).

EXCAVATION RESULTS

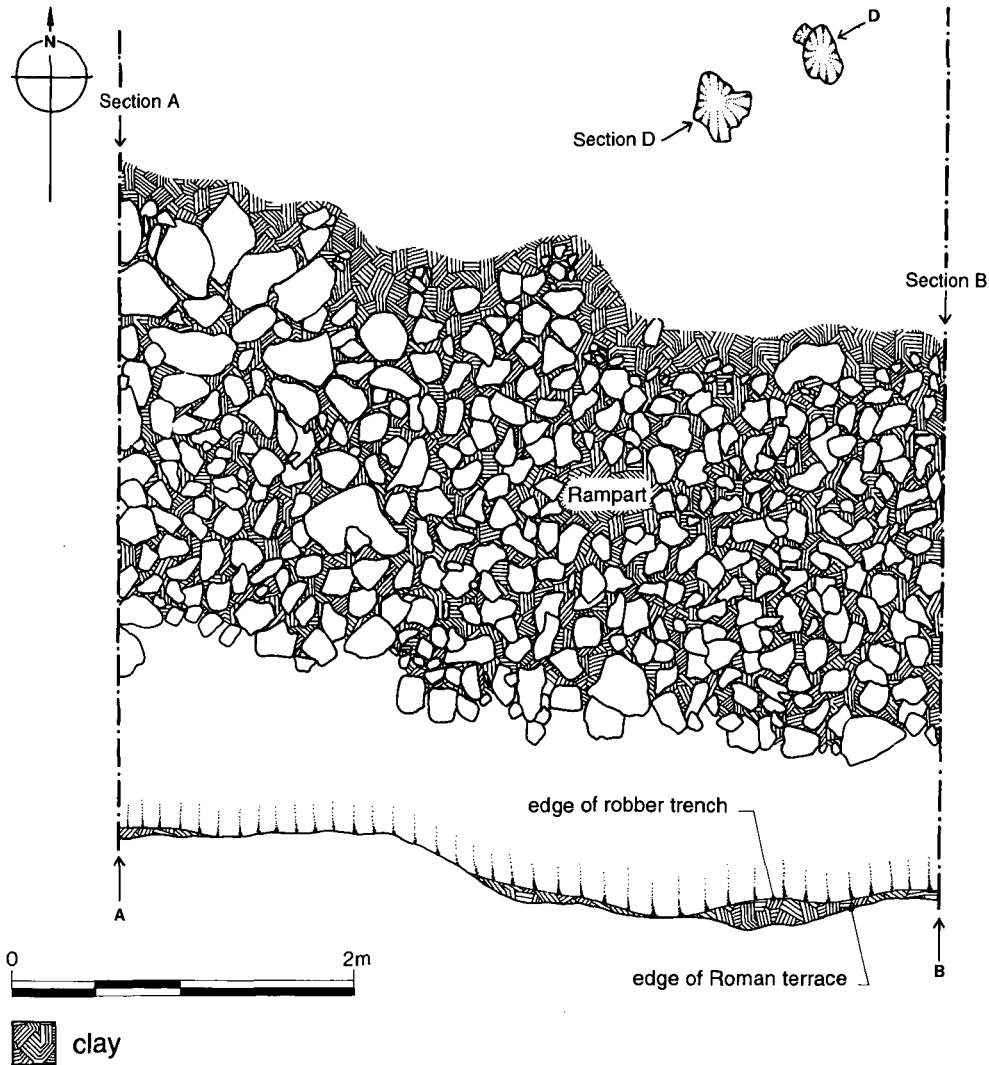
The excavation trench measured 50 m long by 5 m wide, with a keyhole trench 1.5 m wide extending 3 m southwards to the base of the drystone wall dividing the field from the adjacent road (illus 3).

Modern features

The ploughsoil, a dark brown sandy loam c 0.25 m deep, was removed by earth-moving machinery, and it was observed that ploughing had removed most remains above the level of the subsoil. A series of 18th- or 19th-century rubble drains and 19th- or 20th-century tile drains crossed the trench, cutting through the



ILLUS 3 Summary trench plan showing Rampart, Ditch, Outer Mound and other features of interest



ILLUS 4 Plan showing Rampart and associated features

upper parts of archaeological features where they intersected. The subsoil surface in the upper, southern end of the trench was densely scored with plough-marks.

Rampart and associated features

The preserved remains of the Rampart lay c 19 m to the north of the boundary wall (illus 3). The stone base of the Rampart was partially preserved as a band of cobbles and boulders up to 2.8 m wide (illus 4). No kerbstones were identified, and hence the original width of the feature cannot be assessed accurately from the excavated remains. The stone base was bonded and overlain in places by a stiff, pink clay (illus 5, A & B). Very little of the body of the Rampart was preserved *in situ* — a few individual cut turfs, recognizable as alternating laminations of dark, humic soil and light grey silty soil, lay within and immediately upon the pink foundation clay (illus 5, A & B). No more than three stratified turfs survived at any one point. The maximum preserved height of the Rampart was c 0.25 m.

The Rampart had been founded upon a level surface formed by the excavation of a terrace into the hillslope. The rear scarp of this terrace lay c 1 m south of the preserved Rampart base, and was intermittently visible as a steep-sided north-facing cut through the subsoil up to c 0.35 m deep (illus 4 & 5, A & B). The original width of the terrace could not be determined due to plough-truncation of all deposits to the north of the preserved Rampart base, although a width of c 5 m would appear a reasonable estimate.

The southern edge of the Rampart, and much of the rear scarp of the terrace, had been removed by a secondary cut, c 1.1–1.4 m wide by up to c 0.35 m deep, which ran along approximately the same alignment as the terrace (illus 4). Where both these features survived, the southern edge of the secondary feature could be traced cut through a pink silty clay identical to that bonding the stone base of the Rampart (illus 5, A & B). Its corresponding northern edge was more irregular, and appears to have been defined by the remains of the Rampart. The feature was filled with a mixture of silt-clay earth, displaced cobbles and turfs. Its fill extended over the preserved Rampart surface, probably as a result of plough damage. The most convincing explanation for this feature is that it represents a post-Roman ‘robber trench’, cut for the removal of the dressed foundation kerbs for reuse elsewhere and filled with Rampart material disturbed during these operations.

The northern edge of the Rampart was not preserved. The basal kerbs here may also have been robbed for use elsewhere, but the degree of plough-truncation was such that there was no surviving archaeological evidence for any robber trench.

The Ditch and its fills

The Ditch lay c 7.8 m to the north of the Rampart remains (illus 3). It was c 5.8 m wide at its surface and attained a maximum depth of c 2.5 m (illus 6). Its sides sloped down steeply to a squared basal channel measuring c 0.6 m wide and c 0.4 m deep (illus 6). Due to the stepping of the trench edges required to ensure site safety during excavation, and the waterlogging and instability in the base of the Ditch, the basal trench was exposed only for a width of c 1 m (illus 3), and could be defined only approximately. Immediately to either side of the Ditch the ground sloped downwards gently towards it, most probably as a result of erosion of subsoil into the Ditch from either side. The uppermost Ditch fills also occupied this wider hollow (illus 5, C). The exposure of these deposits following topsoiling initially suggested the Ditch to have a surface width of at least 10 m.

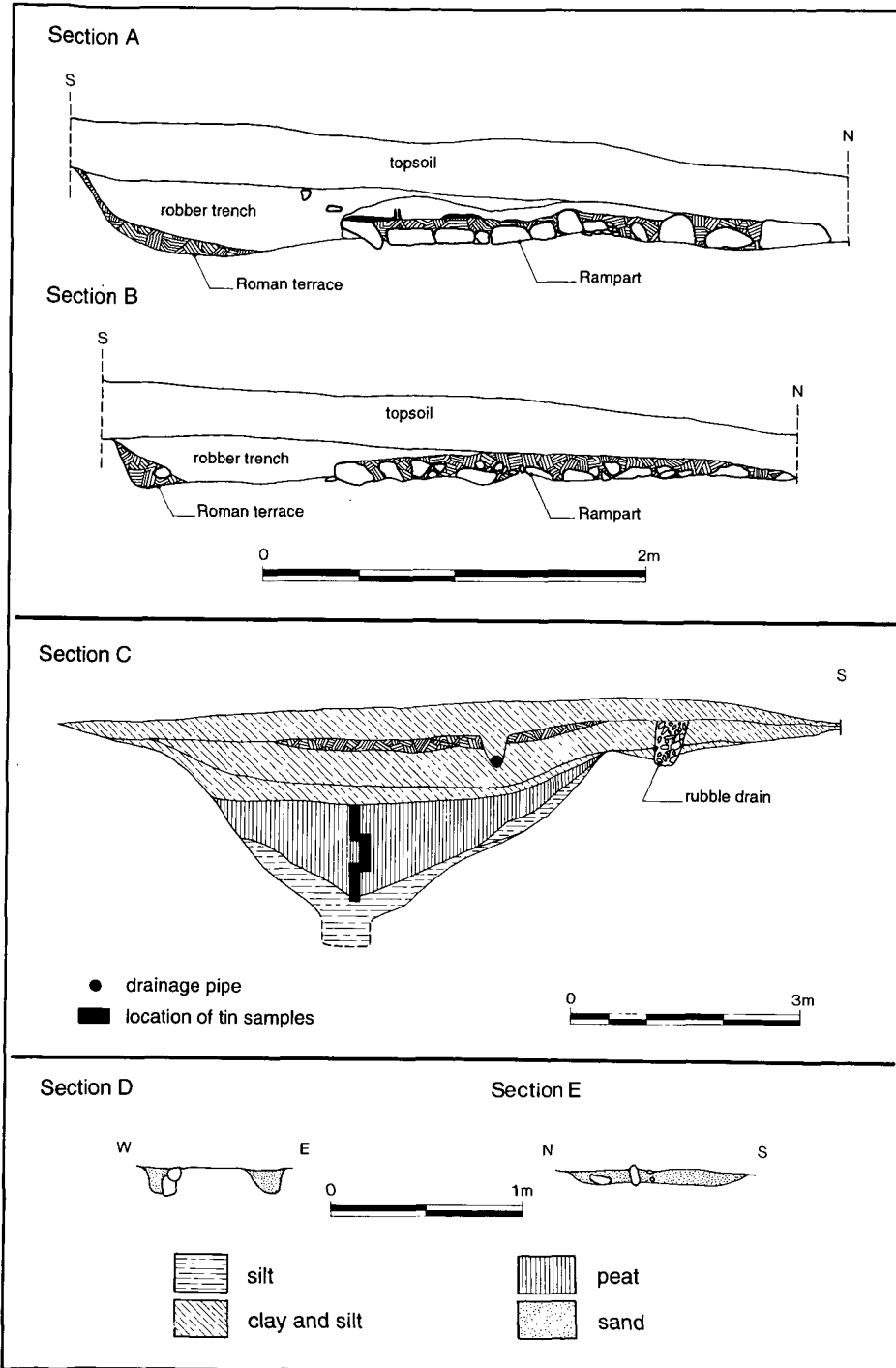
The primary fills of the Ditch comprised fine silts up to 0.6 m deep in the base and thinning to c 0.3 m where lining the sides (illus 5, C). These silts were of very similar composition to the subsoil through which the Ditch had been cut, and it seems clear that they derived as inwash deposits. The ground conditions in the Ditch base during the excavation did not allow detailed examination of these silts, in order to define whether rapid or slow formation was indicated.

A substantial peat formation up to c 1.2 m deep sealed the primary fills (illus 5, C; illus 6). This peat changed gradually with depth from light brown, fibrous material which contained frequent grass stems, rootlets and moss, to a dark brown-black, well-humified peat containing birch and alder branches that showed no signs of working. An alignment of large cobbles and boulders (not illustrated) crossed the Ditch c 0.3 m beneath the upper surface of the peat formation. Given the absence of stone elsewhere within the Ditch, it seems plausible that this feature represents a deliberate attempt to cross the Ditch by laying stepping-stones. Samples of the peat were taken for palynological analysis (see below). The peat formation was sealed below a deposit of clay-rich soil up to c 0.35 m deep.

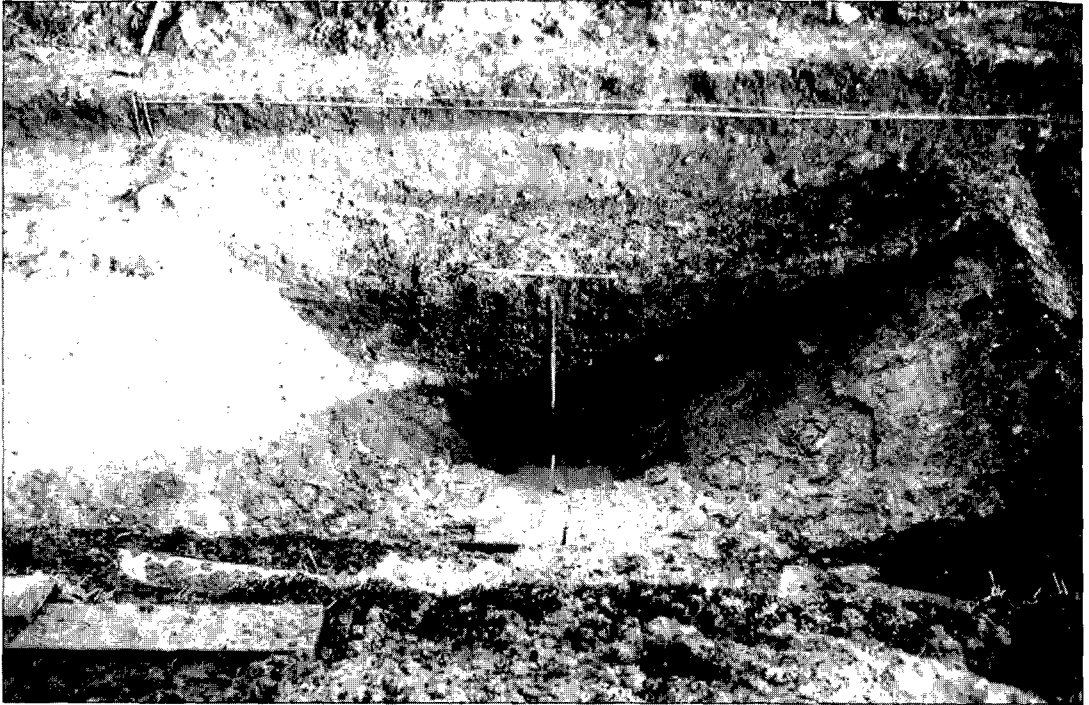
All succeeding fills, with a combined depth of up to c 1.1 m, contained modern artefacts, including glazed pottery and glass sherds, clay pipe stems and fragments of brick. These comprised, in order of deposition, a clay-silt soil, two patches of stiff clay, and a compact, buried ploughsoil.

Berm

The width of the Berm between the Rampart and Ditch can only be estimated, due to truncation of the Rampart and erosion of the Ditch edges. Given the distance of c 12–13 m between the rear face of the terrace bearing the Rampart and the southern edge of the Ditch, and assuming an original width of c 5 m



ILLUS 5 Sections A-F showing the Rampart (A & B), Ditch (C), post-holes (D) and linear feature (E)



ILLUS 6 Detail of west-facing Ditch section, showing the peat formation

for the Rampart (see below), a Berm in the order of 7–8 m wide would appear appropriate. The only certain archaeological features identified in this area were two adjacent small post-holes, located c 1 m north of the preserved Rampart remains (illus 3). The post-holes were both 0.2 m deep, 0.25 m and 0.3 m wide respectively (illus 5, D). The smaller of the two contained packing stones *in situ* and occasional flecks of charcoal.

The Outer Mound

No structural remains of the Outer Mound were preserved. However, a band of red-orange clay soil c 10 m wide and up to 0.15 m deep, merging with the subsoil of similar character to the north, lay immediately to the north of the Ditch, on the presumed former position of the Outer Mound. It probably represents an altered subsoil formerly sealed beneath it (cf Keppie & Breeze 1981, 234, who cite similar examples of the positions of removed elements of the frontier works being reflected in subsoil variations).

Other features

A shallow slot, 0.3m wide, entered the trench from the west, 3 m south of the Rampart, before returning northwards for c 11 m and petering out (illus 3). Where excavated the feature proved to be a squared slot, heavily truncated by ploughing and surviving to no more than 0.05 m deep. The slot was cut through the preserved remains of the Rampart but its relationship with the 'robber trench' could not be determined, as the fills of the two features were indistinguishable. The date and function of this feature are uncertain, although its relationship to the Rampart suggests that it is post-Roman in origin.

A shallow linear feature c 0.95 m wide was located c 15 m south of the Rampart, running from east to west (illus 3). Excavation revealed it to have a single sandy fill no more than 0.06 m deep and a near-level base (illus 5, E). It is possible that this feature represents the truncated remains of a flat-bottomed ditch.

The Military Way is suspected to have run beneath the modern road adjacent to the trench, and it is thus conceivable that the excavated feature may be related to this.

EVALUATION

The excavation demonstrated that the survival of the frontier works within the trench was restricted to the Ditch and the partial foundations of the Rampart. The position of the Outer Mound appears to have been fossilized as a subsoil impression, although no physical remains of the structure itself survived. Tentative evidence for the Military Way was identified. None of the other excavated features is of certain Roman origin. No Roman structures or other occupation existed to the rear of the Rampart at this point, and the absence of Roman artefacts suggests that none was present in the immediate vicinity of the trench.

The Rampart was founded upon a low terrace cut into the hillside, and was constructed of the standard materials for this sector — a turf body on a stone base (cf Keppie 1974). The presumed kerbs of the stone base did not survive and, on the south side at least, had been deliberately robbed at an unknown date for reuse elsewhere. Consequently, the full width of the Rampart could not be ascertained from the excavation. However, a consistent width of c 4.9 m for the base has been recorded in other sections excavated through the Wall between Kirkintilloch and Cadder (Keppie 1974, 158), and a similar original dimension can be envisaged for the section investigated here. A curvilinear slot of unknown function was cut through the preserved Rampart remains, and is interpreted as an unrelated, post-Roman feature.

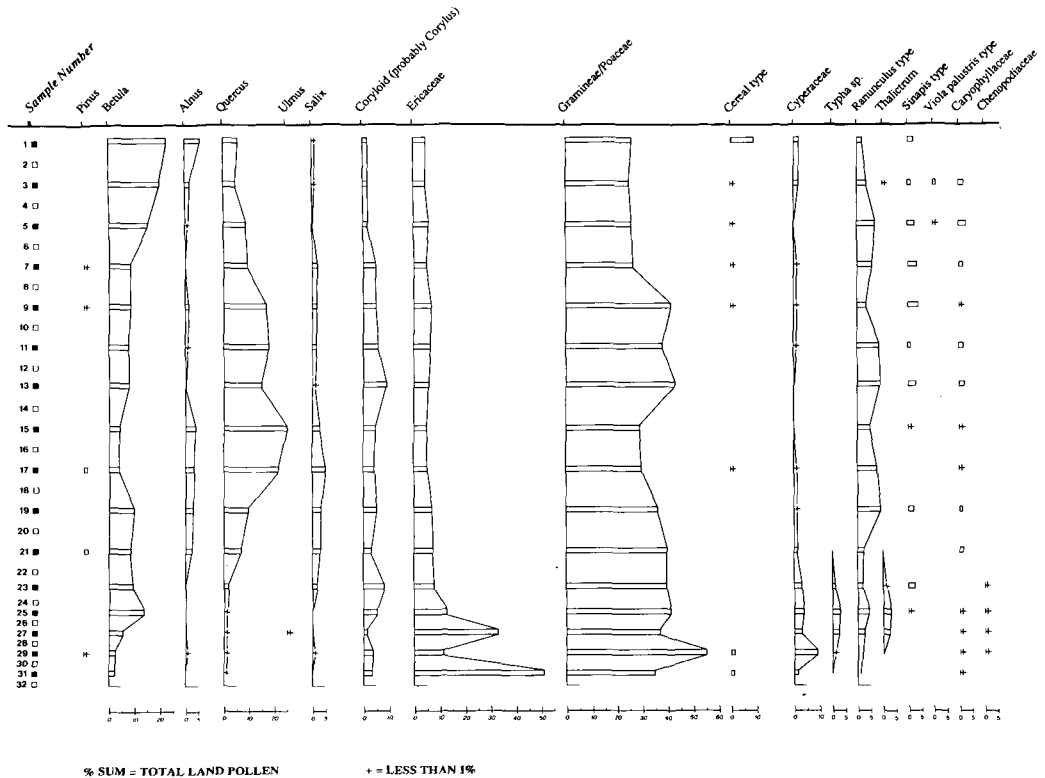
The width of the Berm can only be estimated as approximately 7–8 m. There were no features on the Berm which could confidently be interpreted as contemporary with the Roman frontier works. The two post-holes identified c 1 m north of the Rampart remains may lie in a position formerly occupied by the Rampart but, even if this is the case, it can only be speculated as to whether they would have been sealed beneath the foundation or cut through it, or indeed have been cut following the truncation of the Rampart. On spatial grounds alone a link between the Rampart and post-holes would appear likely.

The Ditch was narrower than had been expected, with a surface width of only c 5.8 m. Following the removal of topsoil it had initially appeared that the Ditch would exceed 10 m wide. However, it was demonstrated that this apparent width was the result of the original upper edges of the Ditch having eroded to create a wider hollow. The Ditch appears to have infilled gradually over a prolonged period (see below) and no evidence of re-cutting was identified. The peaty secondary fill of the Ditch has allowed an important record of environmental and land-use development following the construction of the Antonine frontier to be documented (see below). The upper Ditch fills contained modern artefacts, suggesting that prior to their deposition the Ditch would have appeared as a distinct hollow up to a metre deep: it is perhaps this hollow which would have been recorded by the 18th-century antiquarians cited above.

No certain trace of the Military Way was identified. A flat-bottomed ditch identified at the southern end of the trench, c 15 m south of the Rampart, may be the remains of a ditch flanking this road, although alternatively the feature may be a field boundary or drainage feature of comparatively recent origin.

PALYNOLOGY OF THE DITCH SEDIMENTS

Palynological analysis of the waterlogged organic sediments present in the Ditch was undertaken to establish (a) the local environment in which the Wall was constructed and, (b) what changes in land-use followed the use and abandonment of the Wall line.



ILLUS 7 Pollen diagram based on the sum of Total Land Pollen (TLP)

SAMPLE LOCATION

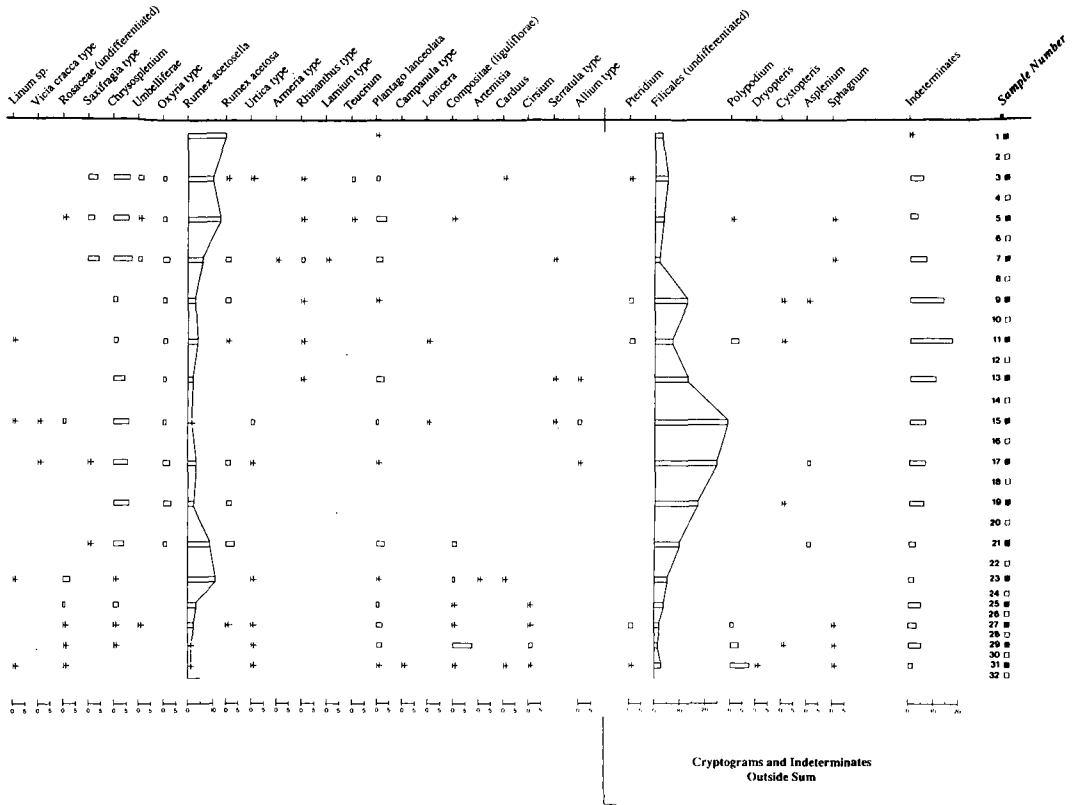
Samples were taken from the cleaned vertical face of section E (illus 5). Bulk samples for later laboratory sub-sampling were taken using three overlapping monolith tins (0.2 m by 0.5 m).

Efforts were concentrated on the lower fill of the Ditch, in particular on contexts which were waterlogged and contained no macroscopic evidence for modern intrusions or disturbance. Samples were not taken from the upper fills, as these all contained modern artefacts and on-site examination revealed the presence of a large number of modern roots together with numerous voids and an abundant soil fauna, suggesting that these layers had been open to modern contamination.

LABORATORY METHODS

In the laboratory the faces of the sample tins were cleaned and described. Sub-samples were taken for loss-on-ignition, magnetic susceptibility and palynology at 10 mm intervals, although only a proportion of these samples at 20 mm and 40 mm intervals were initially examined. Two sub-samples were submitted to the Scottish Universities Research and Reactor Centre at East Kilbride for radiocarbon age determinations.

Loss-on-ignition was carried out at 450°C for 12 hours. Magnetic susceptibility was determined using a Bartington MS2 meter and small pot-sample loop.



Samples for palynological analysis were processed using the standard methods summarized in Moore *et al* (1991) and mounted in 12,000 cs silicone oil. The slides were counted using an Olympus BH2 series microscope under 400 times magnification with 1000 (oil) being used for critical detail. Identification used the key in Moore *et al* (1991) and the reference collection of the Department of Archaeology, University of Edinburgh. Ten traverses of the slide were made; for each sample the minimum count was in excess of 300 determinate grains.

PALYNOLOGICAL RESULTS

The palynological results are presented in a pollen diagram (illus 7) based on the sum of Total Land Pollen (TLP). Ferns and other cryptogams are excluded from the sum but are shown as % TLP for comparability.

Pollen Preservation was recorded using the system of Cushing (1967). Upon analysis, relatively few changes in overall preservation state through the sample column were noted, with the exception of the lower four samples which are discussed in detail below. With the exception of these samples it was concluded that throughout the majority of the period of accumulation of the column the pollen appeared to have undergone similar depositional and post-depositional degradation and in consequence, within the terms of reference of the project, it is not considered necessary to present this data in full since it appeared to add little to our understanding of the site.

Four Local Pollen Assemblage Zones (LPAZ) were identified, termed Antonine Wall Ditch (AWD) 1–4. These zones are indicated on the summary pollen diagram (illus 8) which also shows magnetic susceptibility and organic matter content by loss-on-ignition (LOI). The results are here described in stratigraphic order from the base of the ditch upwards.

LPAZ AWD1 Samples 32–25 The zone is dominated by Ericaceae (heathers) and Poaceae (grasses) which have maximum values in excess of 50% TLP. The base of the zone contains a relatively sparse but diverse herb flora; as one moves up and the primary silts accumulate the ditch appears to be colonized by taxa such as Cyperaceae (sedges), Typha (rushes), *Ranunculus* type (buttercup family) and *Thalictrum* (meadow rue), suggesting the presence of damp open conditions and pools of standing water. This is mirrored by a transition from largely inorganic silts to the deposition of organic silts and eventually peat. Cereal-type pollen is present in low frequencies in the two lowermost samples, 29 and 31.

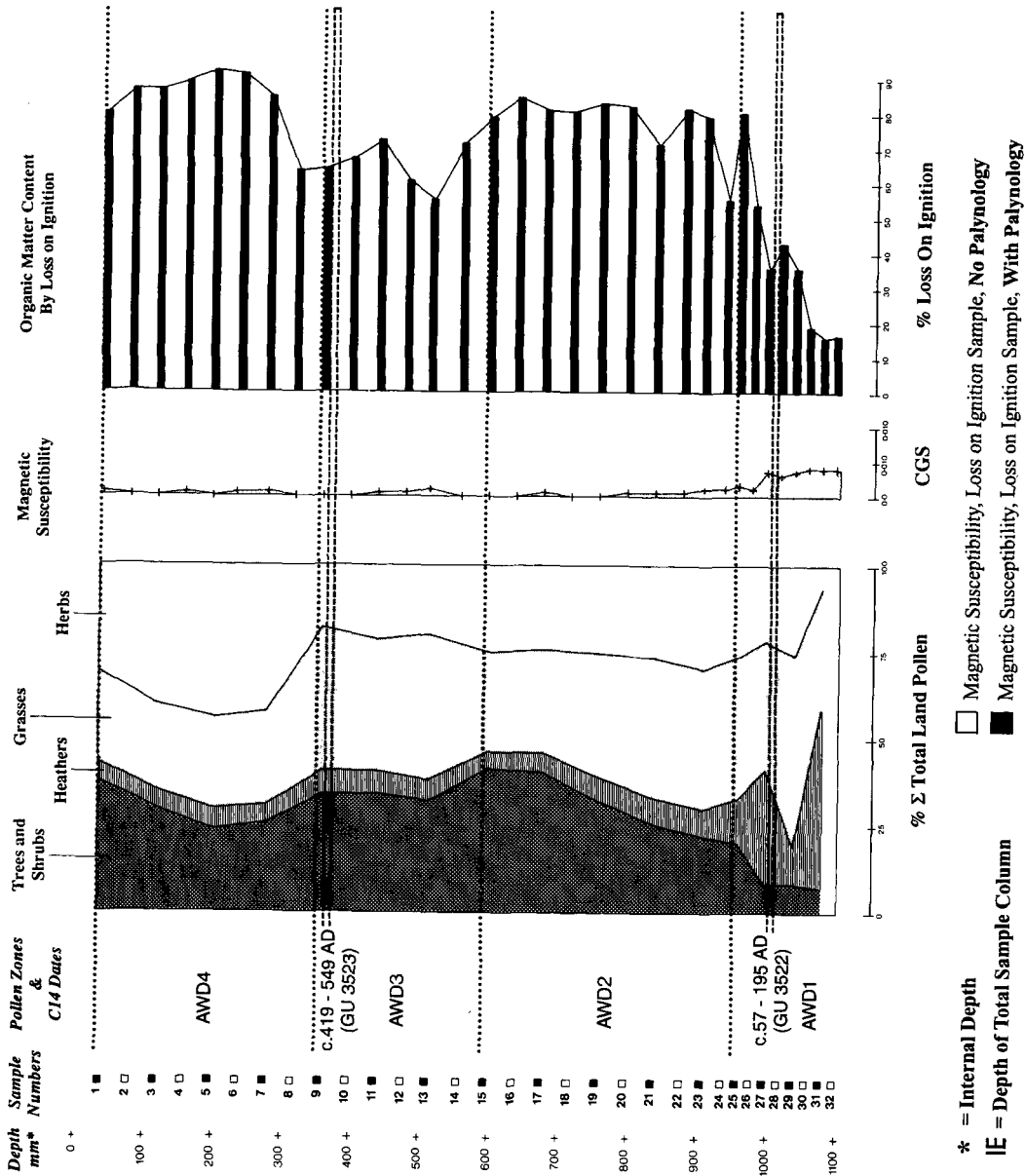
The lowermost sample (31) contains unusually high frequencies of corroded and crumpled pollen. It appears likely that some of the degraded pollen recorded in this sample is re-worked from the old land surface and entered the Ditch in the sediments resulting from the primary weathering and collapse of the Ditch sides. Ericaceae pollen are extremely resistant to weathering (Havinga 1984) and hence are likely to be over represented where recycling from soil to a secondary context has taken place. Since over half the Ericaceae pollen recorded in Sample 31 was degraded, it is suggested that much of the pollen was reworked from a pre-existing heathland soil. A similar peak in Ericaceae pollen in Sample 27 is also marked by relatively high frequencies of corroded and crumpled pollen and it is possible that this also resulted from the inwash of older pollen derived from the soil on the edges of the Ditch. By Sample 25 the ratio of intact to corroded and crumpled grains is similar to that seen throughout the rest of the diagram. Taken overall the pollen preservation data suggest that the marked fluctuations in Ericaceae pollen noted in Samples 31, 29 and 27 result from the operation of taphonomic processes rather than any marked change in the local environment.

Arboreal taxa are relatively rare; arboreal pollen was recorded at its lowest values as a percentage of TLP during this zone. The assemblage contains low but constant frequencies of *Quercus* (oak) and Coryloid (probably hazel), *Betula* (birch) increases throughout the zone, while *Salix* (willow) and *Alnus* (alder) appear only infrequently in Sample 29. As in the rest of the diagram *Pinus* (pine) is present only in very low frequencies (less than 5%) and probably represents long-distance transport from Highland areas further north rather than local growth.

The zone appears to cover the initial silting of the ditch and the gradual colonization of the Ditch floor and sides with an open ground vegetation. The gradual increase in LOI values together with declining magnetic susceptibility further indicates the gradual reduction of sediment inwash following the stabilization of the ditch slopes and the onset of organic sediment ('peat') accumulation in the Ditch itself. Radiocarbon dating of the lowest organic deposits in a position bracketed by samples 27 (above) and 29 (below) yielded a date of 1890 ± 60 BP, calibrated (at one standard deviation) to between AD 57–195 (GU-3522).

This zone appears to represent the period immediately following the construction of the Antonine Wall, the short period of its defensive use and possibly the early phases of its abandonment. The immediate surrounding landscape appears to have been relatively open and dominated by heather and grasses with many rough open ground taxa such as *Cirsium* (thistles). Whether this landscape was already open at the time of the Roman incursion is, given the location of the sample column, obviously impossible to say with any certainty. Nevertheless the high proportions of degraded heather and grass pollen thought to be recycled from the soil surrounding the ditch suggests that the pre-Roman landscape in this immediate area had a heathland aspect. Scrub woodland was present in the general area and, given the gradual rise in *Betula*, appears to have expanded. Cereal-type pollen and so-called 'weeds of cultivation' are present and suggest that arable agriculture was being undertaken in the vicinity.

LPAZ AWD2 Samples 23–15 This zone is marked by the gradual decline of Poaceae and *Betula* together with the rise of *Quercus*, *Alnus* and *Salix*. Poaceae declines gradually from 40% in Sample 23 to under 30%



ILLUS 8 Summary pollen diagram with radiocarbon dates and values for magnetic susceptibility and organic matter content (LOI)

in Sample 15; *Quercus* rises from under 3% to nearly 25% in the same period. This transition is accompanied by the reduction, and in some cases the loss, of the herbs of heathland aspect seen in LPAZ AWD1 and the gradual but pronounced rise of ferns. Cereal-type pollen becomes very rare with only a single (and hence unreliable) grain being recorded in Sample 17.

The Ditch fill becomes markedly woody at this time, with numerous macrofossils of *Alnus* and *Salix*. Not unexpectedly the organic matter content of the ditch fill rises throughout LPAZ AWD1, the lower boundary of LPAZ AWD2 being coincident with the start of consistent values of 80–85% LOI. In addition, magnetic susceptibility falls away to nearly zero, further suggesting the absence of any persistent local sediment input.

This zone appears to represent the period following the abandonment of the Antonine Wall as a defensive line and the colonization of the Rampart and Ditch edges with woodland, initially of a scrubby aspect and composed of *Betula*, *Corylus*, *Alnus* and *Salix*. The rise of *Quercus* and the decline of *Betula* suggest that during the zone the woodland developed, matured and pioneer species such as *Betula* were replaced by more mature woodland canopy taxa such as *Quercus*.

The continued presence of *Alnus* and *Salix* (and possibly also *Corylus*) may be a local reflection of continuing very damp conditions in the Ditch. Since the pollen catchment of this site is very restricted (see below) the extent of this woodland is difficult to gauge but it was, at least locally, sufficiently dense to result in the reduction of open ground herb taxa and grass pollen reaching the Ditch; however the values do not decline so markedly as to suggest regional woodland regeneration and it is reasonable to suggest that at least some open grassland areas did remain within the catchment of the site.

LPAZ AWD3 Samples 13–09 The base of the zone is delimited by the sudden decline of *Quercus* (from 25% in LPAZ AWD2 to under 15%) and the rise of Poaceae (from under 30% to over 45%). Declining frequencies of *Alnus* and *Salix* are also noted together with lowered number of ferns and possible woodland indicators such as *Allium* type. This is mirrored by an increase in herb taxa indicative of open ground conditions, and later the return of sporadic cereal-type pollen and a slight rise in *Betula*.

Sediment input appears to increase as organic matter content values fall from 85% in LPAZ AWD2 to 53% at the base of LPAZ AWD3. Magnetic susceptibility values also show a slight but persistent rise during the lower part of this zone. These changes are mirrored by a decline in the frequency of wood macrofossils in the deposits at this point. A number of fluctuations in the input of minerogenic sediments suggest that at least two phases of disturbed ground conditions took place locally during this zone. A radiocarbon determination obtained from the upper part of the zone and marking the start of the second episode of minerogenic inwash was bracketed by Samples 9 (above) and 10 (below) and yielded a date of 1590 ± 50 BP, calibrated (at one standard deviation) to between cal AD 420–550 (GU-3523).

This zone shows a marked decline in the main woodland taxa together with a rise of grasses and open ground herbs, and appears to represent a period of renewed woodland clearance and ground disturbing activity in the vicinity of the Ditch at this point. While the reduction of major woodland trees is marked the trees do not decline enough to suggest a regional clearance at this time. The paucity of cereal-type pollen together with the abundance of grasses and open ground herb taxa may suggest that clearance was for pasture rather than arable.

LPAZ AWD4 Samples 07–01 The base of the zone is denoted by a marked fall in the frequency of Poaceae (from 45% to 30%) and is further characterized by the continued decline of *Quercus* (from 10% to 5%) and the gradual rise in *Betula* (from under 10% to 25%). While undifferentiated grasses show a marked decline, cereal-type pollen becomes persistent (reaching values of nearly 8% in Sample 1) and herbs increase in both frequency (especially *Rumex acetosella* — sorrel), and diversity suggesting the creation of a greater range of open ground habitats of varying degrees of stability and dampness.

The deposits of the zone show a marked increase in woody macrofossils compared to the previous zone. These are mostly of birch and alder and coupled to the increased organic matter content of the Ditch fill (returning to c 80% LOI, similar to that seen in LPAZ AWD2) suggest the local recolonization of the

Ditch and Ditch edge area by scrub woodland. That woodland here was neither sufficiently extensive nor sufficiently dense at this point to prevent the infiltration of cereal-type pollen and open ground herbs may possibly indicate that this scrub formed a relatively thin band following the line of the Ditch and the remains of the Rampart.

The upper part of the zone shows some evidence for increased local activity, with both a marked increase in cereal-type pollen, disturbed open ground herbs and declining organic matter content. This presages the transition from organic to minerogenic sedimentation in the Ditch and which marks the termination of the palynologically productive deposits.

DISCUSSION

The pollen diagram from Glasgow Bridge would appear to cover a period of some 500–600 years following the Antonine incursion into central Scotland. This period is very poorly understood and is marked by several palaeoecological controversies. The problem is compounded by the paucity of published pollen diagrams from the central Lowlands area, while many of the older pollen diagrams are either poorly dated or not dated at all (eg Newey 1968).

However, before these issues can be discussed it is important to note the limitations which the nature of this site places upon our potential understanding of this period. Two main limitations may be noted:

- (a) The rate of accumulation of deposits in the Ditch will have been far from constant; rapid initial sedimentation may be expected to give way to slower infilling, but periods of ground disturbance with resultant inwash will greatly increase sedimentation for short periods. Such 'stop-go' sedimentation means we can only extrapolate dates between the radiometric dates with caution and pollen influx figures must be seen as potentially misleading.
- (b) As a small terrestrial location the pollen catchment of the site is probably highly localized. It is likely that up to 90% of the pollen recorded is derived from within 100 m of the site. However, and to add further complications, the pollen catchment is itself not constant but is likely to be dependent upon the vegetation cover both adjacent to the site and on occasions growing over it. When the site is in an open landscape the regional pollen component will be relatively large and conversely when the site is covered by dense vegetation the local component will be almost entirely dominant (cf Behre 1982).

In consequence the pollen record from this site should be seen as a highly localized record of vegetation change and should not be directly compared with regional pollen records such as those derived from raised mires or lochs; nevertheless, it is argued that the record is of particular value in determining local responses to the presence of the Antonine Wall in this area.

Whether the Romans encountered a forested or a cleared landscape in southern Scotland is a question which has received much attention in recent years (eg Hanson & Macinnes 1981; Dickson *et al* 1985; Dickson 1992; Dumayne 1993; Tipping 1994; Hanson 1997). This diagram obviously post-dates the Roman incursion and can do little directly to answer this question, although it is interesting to note the very low levels of major forest taxa in the initial stages of the diagram. Since other aspects of the diagram suggest a very open landscape at this time, and hence the regional pollen component reaching the Ditch should be at its maximum, it is possible that the regional woodland values are also low. Whether this represents an already cleared landscape or one cleared for constructional timber following the Roman incursion is a moot point, but the presence of high frequencies of heather and grass together with a diverse herb flora in the lowest samples possibly suggest an already established situation. In short the frontier works were here sited in a substantially open landscape.

A second question concerns the economic impact of the Roman military presence. That the Roman presence may have stimulated economic activity through creating an enlarged demand

for food stuffs such as cereals has been suggested in other frontier zones (eg Hadrian's Wall: Turner 1979; Dumayne 1992 & 1993) and it is here possibly significant that local cereal cultivation appears to have declined markedly, or even ceased, at some time shortly after the Roman abandonment of the frontier, a situation also noted by Boyd (1984). Whether cereal cultivation was the continuation of pre-existing native activity or was an economic response to the Roman presence is difficult to determine given the starting point of this diagram; Boyd (1986) suggested that south of the Clyde in northern lowland Renfrewshire the majority of the landscape was cleared in the Bronze Age and that agricultural activity simply continued apparently unaffected through the Roman incursion.

Nevertheless the presence of cereal-type pollen and disturbed ground taxa appears to indicate that arable cultivation was present in the area at the time of the Roman military occupation. This is interesting in view of evidence from Black Loch in north Fife that the Antonine incursion was associated with a decline in arable activity (Whittington *et al* 1990; Edwards & Whittington 1993). Given the caveat concerning the differential pollen catchments of these sites it is impossible to say whether the Glasgow Bridge evidence has any wider significance within the central belt of Scotland but it does, at the very least, argue for a considerable intra-regional diversity of economic and presumably social and political responses to the Roman presence. That there is considerable local variation is hardly surprising given the regional heterogeneity of post-Roman vegetation changes noted by Dumayne (1992).

The abandonment of the frontier also appears to signal the marked decline in the area of local heathland. This raises the question as to the extent of Roman land management and whether this open grassland heath had been deliberately maintained by periodic burning, cutting or grazing during the occupation. On the grounds of maintaining defensive visibility such practices might appear at least possible; however, this arguably densely settled region appears to have had well-established management regimes (Boyd 1984) and extensive direct interference by the Roman army appears unlikely. Whatever the reasons, the abandonment of the Antonine Wall line signals the start of the gradual regeneration of local deciduous woodland. A post-Roman regeneration phase is also possibly seen in regional pollen diagrams such as those from Black Loch, Fife (Whittington *et al* 1990), Dubh Lochan near Loch Lomond (Stewart *et al* 1984) and Loch Lomond itself (Dickson *et al* 1978).

The start of woodland regeneration is marked by the rise of birch and, given the still relatively high values of heather and grasses, the initial phase would appear to involve the colonization of the heathlands and their initial conversion to a relatively open birch-heath. Over a period of around 200 years this appears to have developed into a relatively, and at least locally, dense woodland dominated by oak with an understorey of hazel, alder and willow. The abundance of alder and willow macrofossils in the profile at this point suggests that the Ditch remained very damp throughout this period.

As noted above, however, it must be stressed that the pollen catchment of the Ditch is restricted and it is possible that woodland regeneration was relatively limited in extent and confined to the area of the presumably collapsed Rampart and the immediate environs of the Ditch. Certainly the continuance of grass pollen levels at around 30% suggest that considerable areas of open ground were still present in the area and it might be wrong to think of this regeneration phase as being of more than local significance. Indeed the continued presence of relatively high levels of grass pollen together with that from open ground herbs and the very occasional cereal pollen indicates that some agricultural activity continued in the area.

This phase of regeneration ends with the renewed local clearance of woodland and the re-establishment of a varied open ground herb flora, together with evidence for increased

minerogenic sediment input into the Ditch, suggesting local ground disturbance. However, it is interesting to note that these changes are not associated with increased frequencies of cereal-type pollen and may, therefore, have been either for crops other than cereals or for pasture. The dating of the start of this phase of renewed local agricultural activity is uncertain for the reasons noted above but would appear to lie around AD 350–400. Fluctuations in the input of minerogenic sediments suggest that at least two phases of disturbance and hence possibly local arable agriculture took place at this time. The start of the second episode is dated to 1590 ± 50 BP, calibrated (at one standard deviation) to AD 420–550.

This local clearance phase comes to an end with the renewed local growth of scrubby birch and alder woodland, again possibly restricted to the line of the Rampart and Ditch. Indeed the presence of increased frequencies of cereal-type pollen and an increased range and abundance of herb taxa points to this woodland being of very restricted extent and it is tempting to think of the Antonine Wall line forming some sort of wooded land boundary in an otherwise largely cleared landscape during this zone. The evidence is therefore equivocal in indicating local woodland growth but with a possibly regional trend towards increased economic activity. This activity eventually leads to the local suppression of peat formation as minerogenic input increases. While, again, it is difficult to date this transition it would appear that it lies sometime around AD 650 to 700.

TABLE 1
Radiocarbon dates

Lab code	Yrs BP	Calibrated dates* (one sigma)	Calibrated dates* (two sigma)
GU-3522	1890 ± 60	cal AD 57–195	cal 30 BC–AD 250
GU-3523	1590 ± 50	cal AD 420–550	cal AD 390–600

*Calibrations were derived by the Scottish Universities Research & Reactor Centre using the University of Washington, Quaternary Isotope Laboratory, Radiocarbon Dating Program (1987).

CONCLUSIONS

The excavation at Glasgow Bridge has provided further evidence for the structural characteristics of the Antonine Wall. By comparison to the corpus of information already obtained from the numerous previous excavations across its line, a further insight has been gained into the variations and local adaptations to topography employed by the builders along the length of the frontier. In this context, the preparation of a levelled terrace for the construction of the Rampart is especially noteworthy.

Palynological evidence from the organic fill of the Ditch has yielded a detailed picture of vegetation change spanning, approximately, the 600 years immediately post-dating the construction of the Wall. It indicates that the landscape in which this part of the Wall lay during the Roman occupation was open heathland and that contrary to the evidence from other areas arable agricultural activity took place in the vicinity during the occupation. Indeed, following the abandonment of the Wall, cereal cultivation showed a local decline in intensity while there is only equivocal evidence for closed woodland regeneration at that time. By c AD 350–400 there is evidence for renewed woodland clearance, expanding cereal cultivation and the encroachment of agricultural activity upon the Ditch resulting in the input of increasingly minerogenic sediments until by c AD 700 peat growth in the Ditch had effectively ceased.

In general, detailed investigation of complete Ditch section has comprised a small proportion of the total number of investigations across the frontier works; this is due, at least in

part, to the scale of the work required to achieve full sections and also the specific aims of previous work (ie to confirm the position of the frontier). This study highlights the significant archaeological potential of the Ditch and its fills for understanding environmental and economic changes along the line of the Antonine Wall, and in general across the midland valley of Scotland in the early first millennium AD.

ARCHIVE

A copy of this report and all site records will be deposited with the National Monuments Record of Scotland (NMRS). Palynological slides and raw data are held in the Palynology Collection of the Department of Archaeology, University of Edinburgh. Finds from the excavation were not claimed as Treasure Trove; their ownership has been transferred to CFA.

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