guests — Building A, a small residential block, was clearly constructed at the same time as the phase B range. It possibly provided accommodation for persons of higher status.

The window mouldings in Building A point to a 15th- or early 16th-century date. A single body sherd of late Malvern flatware, probably a conical bowl, came from L97, a floor make-up level for the phase B range (Fig. 7iii). This would suggest a late 15th- or 16th-century date, given current views on the arrival of late Malvern wares in the littoral of the Severn estuary.[25] A single sherd could, however, be intrusive into this layer.

A crucial problem is the relationship of the industrial phase of activity to the phase B rebuilding of the West Range. This rebuilding certainly post-dates F118, a bowl hearth in the West Range (Fig. 9). It seems likely that this is of the same date as those in the main body of the hall which were also used for cupellation. This remains, however, an unproven assumption.

The last monastic years of the hall are difficult to interpret as the lack of vertical stratigraphy makes the phasing of the many intrusive features there uncertain. Certainly the supposed lean-to structure represented by W71 and the post-holes along the E. wall of the hall make most sense in a roofless phase. It is also unclear if the service chamber, which at some stage had its walls crudely thickened, carried a roof in this period. As suggested earlier, one possible interpretation of the courtyard use in this phase is as stables although there is a lack of positive evidence for function.

SCIENTIFIC ANALYSES

X-RAY FLUORESCENCE. *By* G. McDONNELL

Sample 1 (F47. Bowl hearth fill: Fig. 14). The sample is furnace lining with adhering slag. Copper-alloy corrosion products are present in the slag. X-ray fluorescence (XRF) shows the presence of Cu, Sn, Pb and Fe. A small metal prill was extracted from the slag and subjected to X-ray analysis. It is a high tin-bronze (tin content Sn 10–20%). There is no lead or zinc present. This could, therefore, be bell metal.

Sample 2 (F47). External appearance suggested a part of a metal bar of some form (30 mm max. length, 20 mm diameter). XRF analysis shows that the bar is virtually pure copper, with perhaps 1–2% tin, and of the order of 0.1% lead. No other elements were detected, except for a small iron content.

Sample 3 (F47). A piece of copper waste, in sheet form. XRF analysis shows that it also has a high copper content, with low tin but a reasonable lead content (about 1%). A small iron content was also detected.

Sample 4 (F78, waist-level hearth in N. range, from bowl lining: Figs. 6 and 15–16). This is a lead slag. The XRF showed a high lead content, with a small percentage of copper and tin. Calcium is also present. Two samples of the slag differing on visual grounds were subjected to X-ray diffraction analysis. The first was a typical slag matrix with fayalite (iron silicate) and some wustite (iron oxide) principally lead oxide; two forms of the oxide were present, litharge (red) and massicot (yellow), both with the formula PbO.

The XRD results have not been fully analysed, and there may be other components of lead present.

Summary. Samples 1–3 are the residues of bronze working and the analysis of the prill suggests that this could have been bell founding, especially in the light of the bell mould found in F113. Sample 4 is a lead slag.

ARCHAEOMAGNETISM

The kiln F113, open hearth F46 and bowl hearths F28 and F26 were sampled by Ancient Monuments Laboratory. Results were extremely consistent and indicate a date the mid 15th century for their final use.[26] Unfortunately it was not possible to obtain detailed report.

PHOSPHATE ANALYSIS. *By* C. HERON

	% phosphate by wei
Sample 1, F78, hearth lining (Figs 15–16)	0.35
Sample 2, F118, bowl hearth fill (Fig. 14)	0.15
Sample 3, F28, bowl hearth lining (Fig. 14)	0.10
Sample 4, F46, 'lime' spread on open hearth (Fig. 6)	0.10
Sample 5, L136, levelling deposit (Fig. 7i)	0.03

If the courtyard soil sample (No. 5) can be assumed to represent a backgrou phosphate level at Tintern, then the samples derived from the hearths indicate eleva concentrations of phosphate. The levels in samples 1–4 range from 3–12 times higher th sample 5, but are not as substantial as would be expected if bone ash was present in a quantity. Possibly the elevated levels are due to phosphate from the charcoal fuel. Samp 1–4 all reacted vigorously with dilute HCl, suggesting that lime may have been used a lining instead of bone ash, predominantly calcium phosphate.

THE BELL MOULD (Fig. 20)

The mould comprised an inner core of black loam. Its outer casing comprised s poorly fired clay ranging from buff to red in colour. The fabric was hackly with many inclusions and a tendency to laminate, suggesting it had been subjected to little preparati Inclusions comprised sparse, rounded quartz up to 0.5 mm and moderate muscovite mi plates under 0.1 mm. A nearby riverine source for the clay seems likely.

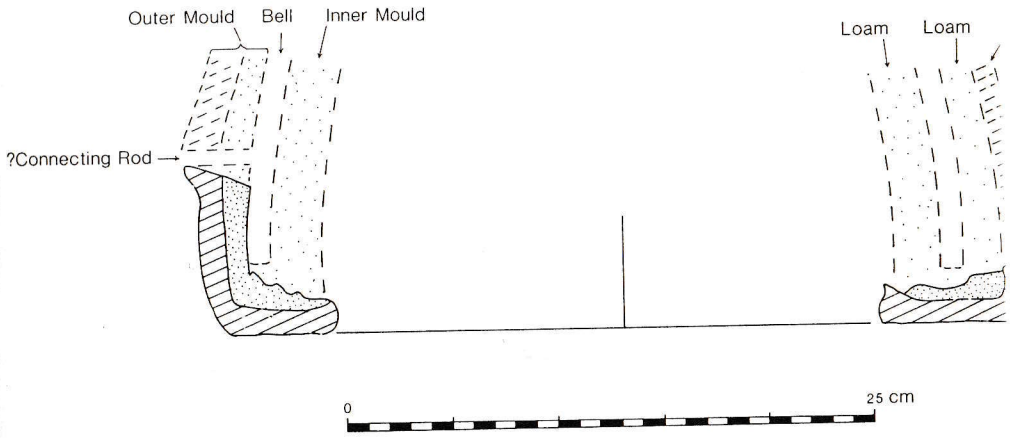

FIG. 20
The Bell Mould

rim sherd from a dish in a buff fabric with a white tin glaze on the exterior and inte
(Fig. 26:43).

43. Dish rim, white glaze and soft yellow-buff fabric. L155, Drain Group D1a: Fig. 11.

Post-medieval Pottery

Most of the early-modern pottery was recovered from residual 19th- or 20th-centu
contexts. F14 and F24 in the hall produced two pot groups of *c.* 1690–1760, and probably th
first half of this period, which are published elsewhere.[44] In addition, the following group
were recovered:
L29 (not illustrated); post-dissolution layer in hall. Tin-glazed earthenware, minimum o
two vessels. Local lead-glazed earthenware (post-medieval), minimum of five vessels.
L12 (Fig. 13): 'Cistercian' type ware (16th or 17th century), minimum of two vessels
Frechen/English 'Tigerskin' stoneware (17th or early 18th century), minimum of one vessel
local lead-glazed earthenware (post-medieval), minimum of eight vessels; Bristol
Staffordshire mottled ware (*c.* 1690–1760), minimum of one vessel.

Romano-British Pottery

The excavations of 1970–71 and 1977–80 in the outer precinct produced a number o
sherds of Romano-British pottery, but these are likely to have been brought onto site with
levelling deposits from elsewhere. They suggest settlement in at least the 3rd century and
possibly the 2nd to 4th centuries.[45]

ENVIRONMENTAL ANALYSES

THE ANIMAL BONES. *By* G. G. JONES

The 13th-century Layers

Layer 136 (Fig. 7i–ii) and related layers, a clayey levelling deposit mixed with midden
material, occurred over most of the site, and pre-dates the construction of the hall. The bones
were generally very fragmented, with only 31% of bones being identified, and half the cattle
and nearly half the sheep bones being classified as fragments. Bones from cattle were the
commonest in layer 136, and the low number of identified horse and red deer bones at the site
means that most of the large-species unidentified bones are doubtless from cattle: 62% of the
unidentified were large. These include 133 ribs, many of them surviving in quite long sections
(100–200 mm).

Layer 81 (Fig. 7i–ii) was stratigraphically equivalent to L136 but differed in having a
relatively higher proportion of sheep to cattle bones. Comparison of large- and sheep/pig-size
unidentified fragments shows a similar pattern, so there appears to be a real difference in
disposal, with the larger bones of cattle tending to be deposited in the courtyard. Cattle,
sheep and pig bones from L81 include bones from most parts of the skeleton, but the high
meat-bearing vertebrae and upper limb bones formed the major proportion. This would be
the type of deposit to be expected near a midden with waste from kitchen, guest-house or
refectory.

The minimum number is given in parentheses in Table 1. It is probably a great
under-estimate of the number of individuals whose remains were excavated. The bones
rarely appeared to be related to each other, either as clear left/right pairs or articulated joints,
e.g. no layers included an astragalus and distal tibia which fitted together.

In comparison with L81, L136 seems of a more general character, with more bones of the
head and foot of cattle, and the bones somewhat more fragmented. However, the L136 sheep
bones also show low proportions of skull and foot waste, so that the general character of the
13th-century bone sample as a whole suggests proximity to areas of domestic activity.

TABLE 1
SUMMARY OF ANIMAL BONES

	Cattle BN	Cattle MN	Sheep BN	Sheep MN	Pig BN	Pig MN	Other mammal/bird	Fowl	Fish	Unident. lge	Unident. med	Total
13th cent.												
L136	104	(4)	81	(6)	22	(3)	cf. red deer 2a roe 2 crow 1	1		246	150	609
L81	56	(2)	89	(6)	36	(3)	horse 2 duck 1 cormorant 1	1	p	214	268	658
Total (398 identified)	160 40%		170 43%		58 15%		Other 4 bird 3 1%	2 1%	p	460	430	1267
W. Range Phase A L112, L154	8	(1)	18	(2)	7	(1)	cat 1	1		8	12	55
Mid 15th/early 16th cent.												
W. Range constr., Phase B	16	(2)	21	(2)	15	(3)	red d. 3, roe 1 rabbit 7 (1)	13(3)	p	12	22	110
Drain 1 fill	120	(9)	37	(5)	25	(4)				76	62	320
Drain 2a							horse 1					1
Total (249 identified)	136 55%		48 19%		40 16%		Other 12 5%	13 5%	p	88	84	431

Notes
BN — number of bones; MN — minimum number of individuals; lge — unidentified bone from large species; med — medium (sheep/pig-size) and small (3
unidentified small mammal and 7 bird bone fragments); a — antler; p — present.

Butchery marks were common, either from choppers or knives. Vertebrae were usually in a fragmented state, but none were clearly chopped sagitally which would indicate dividing of the carcase down the midline.

Some bones seem scarce, notably horncores, with only three of cattle and none of sheep or goat, and only three cattle metapodials, the bone most often used for bone-working, against 23 cattle phalanges. Horn- and bone-working therefore probably took place elsewhere.

Bones from species other than cattle, sheep and pig were few but included roe deer, represented by bone and not antler. Two antler pieces, probably from red deer, had been chopped through, not sawn as is more usual. Horse was represented by two teeth. Only four bones of fowl were found, and one of duck, which may be domestic or wild mallard (*Anas platyrhynchos*). Two other bird specimens were found, a crow bone (*Corvus corone*) and a cormorant bone (*Phalacrocorax carbo*) (see discussion).

The 15th-/ early 16th-century Bone

The small group of pre-mid 15th-century bones (phase A) produced bones from cattle, sheep, pig and fowl, plus the only record from the site of cat (a mandible from layer 154, Fig. 7iii).

The mid 15th-/ to early 16th-century bones (phase B) came from the West Range and Drains 1 and 2a (Figs. 7iii and 11). As a whole the bones were less fragmented than the earlier material, 53% being identified and a smaller proportion (one third) being classed as fragments.

The bones from the West Range construction were well preserved, including bones from red and roe deer, rabbit, fowl and fish, and the proportion identified was high (70%). Pig and fowl bones were both nearly as numerous as cattle (and more numerous by minimum number count). As with the earlier bone group, red deer and roe were both present, with apparently no fallow deer. The deer remains were all bone, indicating food waste not antler-working. The rabbit bones were examined for butchery marks without success, which means they could be intrusive. However, the presence of a rabbit warren would not be unexpected. The bones from these layers suggest that a fine and varied table could still be served at the Abbey at this late date.

The higher percentage of cattle shown for the later group in Table 1 is affected by the deposits from Drain 1, where cattle formed 66% of the identified bone. The deposit was unusual, with numerous remains from cattle skulls and feet. The 120 bones comprised 81 from the head (49 of them loose teeth), fourteen from the main part of the body and 25 from the foot. Similarly, 77% of the sheep and pig bones were from the head or foot. The bones, although not highly fragmented when deposited, were badly eroded. Seventeen cattle metapodial bones were found, most of which were probably complete originally, but they were too eroded for any measurements to be taken, even of shaft widths.

Interestingly, there were of these cattle metapodia a good deal more from the left than the right side: two right and six left metacarpals and two right and seven left metatarsals. Bones from the main body were too few for significant comparison and skull remains were not so biased. It could be that in the distribution system the right side tended to be allocated elsewhere or perhaps right metapodia were preferred for bone-working. Corroboration for neither idea was available, since none of the few vertebrae were split sagitally and no worked metapodia were found.

The single equid bone was a 3rd phalanx from a small horse.

Discussion

The bone sample found at Tintern is small, but it is the only such collection and is of interest for this reason. The 13th-century bone sample, dating from the height of the Abbey's importance, appears to be refuse from domestic activity. Differences in

the bones found in L136 and L81 (Fig. 7) showed the deposition of relatively m the larger bones of cattle in the former. Such difference serves as a caution in t overall percentages as anything other than a very general guide to species ir tance. But it can be said that most meat eaten was beef or sheepmeat, and mos from sub-adult or adult animals. This age structure is similar to that found at sites. A bias towards younger animals might be expected in the supply of anim the Abbey itself, but this seems not to have been the case.

The bone groups from the 15th-/ to early 16th-century layers again differences, especially between the Drain 1 fill which was dominated by cattle bones and the West Range-phase B construction deposit which more nearly ca mind the medieval banquet with beef, mutton, pork, venison — both red an deer — ?rabbit, fowl, cod and conger eel.

Taken as a whole, the 15th-/ early 16th-century bones do not indicate any change in diet since the earlier bone group, with the exception of a relative inc in pork eaten, the probable presence of rabbit and perhaps a higher frequency of (and hence perhaps eggs also).

Venison appears to have been eaten occasionally. The bones (exclu antlers) of red deer and roe formed just 0.9% of the total identified bone, thoug percentage was higher from some individual layers.

Cormorant, present in the 13th-century period, winters but does not bre the area of Tintern today.[46] The Wye at Tintern is about 80 m wide and alth 15 km upstream from the confluence, it is only 5½ km overland from the Se estuary. The record could be of a non-breeding bird but it is also possible colonies used to nest in trees in the area. On the Continent tree-nesting at inland is fairly frequent, but this is no longer so in Britain due to persecution by fisher Cormorants eat primarily flatfish, shore and estuarine fish but the usual pre rivers are Brown Trout, Perch, young Salmon and Eels.[47] The bone could of co be a natural occurrence but perhaps it is a trophy trapped or shot to protect Abbey fish stocks.

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