INTRODUCTION

The early medieval monastery of San Vincenzo al Volturno stands high in the Mainera of Alto Molise, some two hundred kilometres south-east of Rome. Excavations have been conducted on the site since 1980, and a large area of the eighth-century foundation has been uncovered. The results of the first phase of the project are described in a series of scientific publications and numerous interim reports (Hodges 1993; Hodges 1995; Mitchell, forthcoming). Since 1989 the project has focused on the archaeology of the ninth-century basilical complex of San Vincenzo Maggiore and the monastic workshops (Hodges and Mitchell 1995). The full results of this work are to be presented in a number of forthcoming volumes. The purpose of this paper is to give a brief account of an on-going research collaboration based on the excavation of a sequence of temporary workshops associated with the construction of the abbey-church of San Vincenzo Maggiore.

The archaeology of the diverse aspects of ambitious ninth-century building programmes such as that witnessed by San Vincenzo has suffered the same exigency that has afflicted the buildings themselves during the intervening centuries. Churches and monasteries tend to be reoccupied and rebuilt in later periods, leading to the disturbance of deposits relating to their construction. However, following the sack of the monastery by Saracens in 881 and the later abandonment of the site in the eleventh century, significant evidence of an impressive ninth-century expansion at San Vincenzo has been preserved beneath deep layers of agricultural soil. This happy circumstance has enabled a detailed examination of the organization and mechanics of the building of a major Carolingian-period monastery.

The history of San Vincenzo is written in the twelfth-century Chronicon Vulturnense (Federici 1925-38). The community was established in 703 by three Beneventan monks from Farfa, on the site of an abandoned oratory associated by legend with the Emperor Constantine. The site was granted by Duke Gisulf I of Benevento on the northern extent of his realm. Towards the end of the eighth century a massive reconstruction was launched by a number of the monastery’s Frankish abbots. Following Charlemagne’s crossing of the Alps in 773, the Upper Volturno valley assumed capital importance on the political map of the peninsula in this period. Following the subordination of the Lombard Kingdom and the Duchy of Spoleto, San Vincenzo found itself on the frontier between the Carolingian Empire and the defiant southern Lombard Duchy of Benevento. In 787 Charlemagne entered Benevento, and in the same year the sack of the monastery by Saracens in 881 and the later abandonment of the site in the eleventh century. San Vincenzo has been preserved beneath deep layers of agricultural soil. This happy circumstance has enabled a detailed examination of the organization and mechanics of the building of a major Carolingian-period monastery.

THE EXCAVATIONS

The monastic complex was developed and expanded throughout the ninth century, beginning with the basilica of Abbot Joshua consecrated in AD 808. Building commenced at the western or apsidal end of the church during the late eighth century and continued eastwards. A large raised atrium with a pilastered façade flanked by two towers was added to the east end of the church during the age of Abbot Epyphanius (824-842). A vaulted passage beneath the new eastwork served to unite the liturgical and industrial heart of the monastery with the cloisters and an area reserved for distinguished guests to the north.

Excavations below the eastwork of San Vincenzo Maggiore over the last fourteen years have revealed a number of phases of workshop activity and production, all of which can be linked to successive episodes of expansion and development within the monastery. The first of these is associated with the building of Joshua’s basilica. This was a massive undertaking which included the construction of a series of temporary workshops, situated to the east of the eventual site of the monumental façade, where all the furnishings and fittings destined for the new church were prepared in advance (Fig. 1). The second phase is assigned to the construction of the atrium, which was combined with the creation of a range of collective workshops along its south flank (Hodges 1991). Each of the workshops identified in this phase was responsible for the production of a particular, highly-specialised craft, including enamel-making, bone and ivory-working, and the production of elaborate iron cavalry equipment, skilfully inlaid with silver. Alterations made to one of the workshops after the great earthquake of 848 (Guidoboni 1989) suggest that a chamberlain was assigned to control and oversee production, which appears in part to have been destined for members of the local elite. Evidence from the excavations shows that the collective workshops remained in use until the day the monastery was sacked by Saracen raiders on the tenth of October, 881. In this paper, the early workshop phase associated with the construction of the basilica will be described, including details of the wealth of technological material uncovered to date.

THE TEMPORARY WORKSHOPS

The earliest phase of production at San Vincenzo can really be considered as industrial rather than artigianal on the basis of the scale involved and the utilitarian nature of the materials and objects produced. Production took place in what has become known as the builders’ yard: a series of large, open-plan buildings complete with kilns, which seem to have been purposefully built for the large-scale manufacture of materials in advance of the construction of the basilica. Production can be further sub-divided into three distinct phases of activity in the form of tile making, bell-casting and bronze-smelting and, finally, glass-working. At the end of each phase, the workshops and their associated furnaces were demolished and new ones built above the old. Evidence from the excavations shows that the sequence of workshop destruction levels. The sequence is represented by three and a half metres of stratigraphy which is only partially excavated due to the extant eastwork and atrium.

TILE PRODUCTION

The initial phase of activity in the builders’ Yard is represented by a huge kiln complex where hundreds of roof and floor tiles were made in preparation for the church. Two structures partially excavated below the standing eastwork span an area of over twenty metres and may represent different parts of the same furnace: in one area, the visible structure comprised three narrow walls built of Samnite

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dolium fragments and Roman and early medieval tiles bonded with clay, forming two parallel flues, 0.90 m wide. The flues, which were possibly vaulted originally, were at least four and a half metres long and lined square with a cross-wall built of the same material. A second, possibly related structure, was located running transversely to the flues. This comprised one half of a fan-shaped, vaulted chamber, approximately two metres wide, with a pierced tile floor. The walls were built of alternating courses of cylindrical and rectangular bricks bonded with clay. Although it was not possible to investigate the area between the two structures, they are almost certainly related and are provisionally interpreted as the flues and firing chamber of a large, possibly L-shaped, tile kiln.

THE BRONZE AND COPPER-SMELTING WORKSHOP

After tile production had ceased, the kilns were partially demolished and backfilled and the workshop area was levelled with clay. The remains of two walls aligned east-west, some nine metres apart, suggest that a temporary workshop was constructed to house the metal-working kilns. The full width of the building is unknown as it extends beneath the later atrium, although it spanned at least four and a half metres.

A second phase of industrial production then came into operation in the form of bronze working. Two of the features associated with the bronze workshop appear to have been the first in use: a small, square kiln found in the southern end of the workshop was skillfully constructed of roof tiles laid horizontally and bonded with clay and sand. At the base of the kiln was a mixture of charcoal and fine white sand which probably represents the remains of the final firing episode. The fill suggests that the kiln may have been used for the reduction of copper ore, whereby roasted ore is placed in a kiln along with charcoal and a flux such as sand. The sand and frit. The pits may have functioned as storage bins initially and later, as waste containers for the workshop. Finally, three identical, deep post-holes located together close to the southern kiln suggest the existence of a tripod-based structure or mechanism, perhaps a manually-operated bellows used to fuel the furnace.

BELL-CASTING

Excavations at Rocca San Silvestro in Tuscany (Brunn 1993). The upper part of the kiln was filled with pieces of refractory material, including the remains of smashed sieges which contained the bowl-shaped impression of a large crucible with a base diameter of around 10 cm. Surviving hand-prints made by the builders on the outer edges of the sieges, together with tile flange impressions on the underside, showed how the kiln had been shaped and moulded by hand from clay onto a tile base. Although the clay has not yet been analysed, it is likely that it resembles refractory materials from other smelting sites in that it comprises a fairly low-grade material, gathered locally by the craftsmen building the kiln (Freestone 1989). In fact, analysis of crucible fabrics from San Vincenzo has shown that the clay was derived from Collis a Volturno, some six kilometres from the monastery (Patterson 1992). The sieges have yet to be reconstructed and consequently, it is not possible to determine whether it is derived from the upper part of the kiln in which it was contained, or from the sieges. One or two very thin layers of glass frit on the sieges suggest that it may relate to the later glass kiln complex.

The second early feature of the metal workshop was located two metres away from the copper kiln and comprised a large, globular ceramic vessel which had been tightly inserted into a specially-dug pit in the ground. A small ceramic bowl had been inverted over the vessel to form a lid. The vessel stood approximately 30 cm high and may have served as a reservoir for water or other liquid substance associated with the metal-working process. In his twelfth-century treatise, De diversis artibus, the German monk Theophilus describes the use of wine or urine as a quenching and hardening medium for metals. More interestingly, he also mentions the use of wine or urine as an amalgam to bond copper powder and ground glass in the making of stained glass (Hawthorne-Smith 1979, p. 63). The presence of the copper kiln, glass residues and the reservoir within the first phase of the metal workshop may suggest that stained glass, destined for the church windows, was being made at this time.

A number of later features within the metal workshop partially conceal the copper kiln and reservoir. The primary structures comprise the ground-level working platforms of two kilns located five metres apart at the southern and northern ends of the workshop. The two structures, which were both slightly larger than a square, were made of roof tiles set horizontally onto mortar bases. The remains of limestone and tile walls bonded with mortar were found surrounding the kilns. The bases of both structures contained channels and lines of tile fragments set vertically, possibly to form a kind of flue mechanism or perhaps to direct molten metal. Deposits of ash, bronze splashes and crucible were found in association with the two kilns. The tile platform of the southern-most furnace had small pieces of bronze and iron adhering to it.

A complex series of clay-cut features including postholes, gulleys and pits are associated with the metal workshop. Two shallow pits contained fine multi-coloured sand which appeared to have been subjected to heat. Small splashes of bronze found within the fill suggest that the sand had been utilised in the kilns, probably as a flux. Two large oval pits contained fine, ashy sand deposits with many burnt inclusions, including charcoal, stones, clay, bronze lumps and frit. The pits may have functioned as storage bins initially and later, as waste containers for the workshop. Finally, three identical, deep post-holes located together close to the southern kiln suggest the existence of a tripod-based structure or mechanism, perhaps a manually-operated bellows used to fuel the furnace.
particularly of the cope or outer mould, as a result of the greater reducing atmosphere during firing (DAVIES-OVENDEN 1990, p. 118). A preliminary examination of the San Vincenzo bell-mould suggests a high percentage of reduced fragments indicative of the lost-wax method, although a full analysis of the material is yet to take place.

During the lost-wax process described by Theophilus, the wax was melted from the mould and after the mould had been fired for a day and a night, the stone furnace structure, vaulted flues and the remains of the fire would have been quickly removed from the pit (HAWTHORNE-SMITH 1979). The pit would have then been re-filled and earth or clay packed around the prepared mould while the bell metal was being prepared. During excavation of the San Vincenzo bell pit, large quantities of carbonized wood and burnt material including clay, tile, bell-mould and travertine were recovered, together with small “splashes” of bronze. These deposits represent the remains of the temporary furnace and broken mould, which were used to back-fill the pit after the bell had been cast. The bottom of the pit contained layers of sand which had been thrown in to raise the finished bell. Part of the original clay and stone lining of the pit, heavily burnt, remained in situ.

Theophilus describes how, during casting, the molten bronze was usually poured into the mould by hand from crucibles. At San Vincenzo, the distance of seven metres to the nearest, contemporary bronze furnace seems somewhat impractical, suggesting that the metal may have been channelled from a smelting furnace built next to the pit at ground level (MARINELLI, pers. comm.). The remains of a burnt, linear stone structure were located on the ground surface, together with a rectangular, clay-lined pit which contained copious quantities of ash, charcoal and crucible sherds. The pit may have functioned initially as a clay quarry and water reservoir during the making of the mould and subsequently, as the base of the smelting furnace. Unfortunately, pieces of bell-mould found within the pit showed that it had been back-filled after the casting had taken place and that all associated structures had been destroyed, as is often found to be the case (BLAGG et al. 1974, p. 428). A large piece of bell-mould recovered 10 metres away from the bell-casting pit probably represents part of the inner core. Preliminary analysis of the residue suggests that the finished bell had a diameter of between 0.45 and 0.50 m and would have weighed in the order of 50 kilograms. The mould appears to be made from a fine, silty clay with mica inclusions and occasional pieces of organic material, possibly straw.

In summary, the bell-casting pit excavated at San Vincenzo can be closely identified with the description given by Theophilus. In terms of typology, two principal types of bell-pit have been suggested: the horizontal draught furnace and the circular pit which acted as an updraught kiln (BLAGG et al. 1974). Although the San Vincenzo bell-pit was not fully excavated it seems more likely that it falls within the second category. The distinction seems to be geographical rather than chronological, with most, although not all, of the circular bell-pits confined to Italy.

Bells were normally cast a short distance from where they were to be hung and it is almost certain that the San Vincenzo bell was destined for the bell-tower which was constructed directly above the levels of the casting-pit during the first half of the ninth century. To the authors’ knowledge, no other bell-pits are known for this period although research is currently in progress. A bell-casting pit excavated within the Old Minster at Winchester and dating to the tenth century was of the horizontal-draught type (DAVIES-OVENDEN 1990). Quite a few examples are known from slightly later Italian contexts, including an eleventh-century bell-pit from Venosa (VIDALE et al. 1992), a twelfth-century example from Sarzana in Liguria (BONA 1975) and a twelfth-century bell-pit from the Torre Civica at Pavia excavated by Ward Perkins (1974).

THE GLASS WORKSHOP

When all bronze-working activities had ceased, the building and its’ associated furnaces were demolished to foundation level and covered with tips of clay and rubble. A new workshop, destined for the large-scale production of glass, was built directly above the remains of the previous
The true extent of the glass workshop is presently unknown as it extends below the later atrium, although the foundations of one wall have been identified extending east-west below the corridor. Extant structures within the building comprise a large kiln located in the centre of the corridor and a low stone bench which extends for six metres along the western side. A corner kiln is situated at the junction of the bench and the surviving north wall, in what may have been the north-west corner of the glass workshop. This takes the form of a semi-circular structure made of tiles, which may have had a chimney. Only the floor-level hearth survived, which contained the remains of a possible stokehole. Ash deposits found within the kiln contained glass fragments, glass waste and bronze slag. The structure may have functioned as a subsidiary furnace, possibly for the melting of waste glass as cullet which is known to have been imported to San Vincenzo in huge quantities in the form of vessel glass and coloured glass tesserae (Hodges 1991, p. 75).

The main focus of the glass workshop is the large, possibly central furnace which consists of an L-shaped or tripartite structure with a central flue and connecting ashpits (Fig. 2.). The flue consists of a square pit, 70 cm wide and 70 cm deep, dug in to the ground and lined with tile fragments bonded with clay and mortar. Both the tiles and the mortar lining of the pit were heavily vitrified. A ring of burnt, red clay which surrounds the pit testifies to the fierce heat which was contained within it when the kiln was in operation. The clay ring, which has a diameter of 1.7 metres, was initially thought to represent the remains of an earlier, circular kiln, although its' perfect positioning around the pit suggests that the two are related. The bottom of the flue pit contained layers of ash and charcoal and a large quantity of vessel and window glass and glass-working waste. A second, much smaller mortar-lined pit located in front of the western hearth may represent another ashpit or possibly a second flue mechanism. The mortar lining of the pit was vitrified showing that it had been subjected to extreme heat. A clay disc with a central perforation found within the ash fill of the pit may represent the remains of a glory hole or boccarella (Charleston 1978, p. 15). The perforation, 12 mm in diameter, represents the hole where the glass-blower’s iron rod was inserted into the kiln. A second, identical disc was recovered from demolition debris excavated above the kiln.

The remainder of the furnace structure comprised two square platforms or hearths which were attached to the northern and western sides of the mortar-lined flue. There was also evidence for a third platform which would have originally extended to the south of the flue. The working surfaces of the platforms, which were made of tiles, were situated slightly above the floor-level of the workshop supported on tile and clay bases. The platforms probably represent the hearths or sieges on which the crucibles would have been placed. To the south and east of the flue pit were two pairs of oval ashpits which had been dug into the ground. The ashpits contained immense quantities of glass waste in the form of moils: the remnants of glass removed from the blowpipes during glass-blowing. The moils indicate that the diameters of the blowpipes ranged between 10 mm and 15 mm – in keeping with the holes in the boccarella. Other glass-making debris included clippings and trimmings of glass and reticelli rods which were used to decorate the tops and sides of glass vessels.

It is not clear whether the flue pit was originally covered by a central platform or whether it remained open. Initially, the absence of an air channel leading into the pit was puzzling, although it is possible that air was fed into the kiln at hearth level. A very similar glass furnace dating to the 14th or 15th century was discovered in the Genoese Apennines (Mannoni 1972). The main characteristic of the furnace was a central, mortar-lined flue pit surrounded by sieges and connected to a single ashpit. Wind was apparently channelled naturally into the flue from stone slabs surrounding the ashpit. The circular kiln probably had a domed cover. This type of glass kiln, known as a “Southern” furnace (Charleston 1978) consists of a three-tiered structure: the bottom storey of the kiln contains the fire and a single stoke-hole. The middle chamber contains the crucibles and is accessed by multiple glory holes and the upper part of the kiln is used to cool or anneal the finished vessels. The southern type of furnace therefore required that all three processes of fritting, founding and annealing were carried out in the same structure. A large, southern furnace dating to the seventh or eighth-century is known from a glassmaking complex at Santa Maria Assunta on the Venetian island of Torcello (Leciejewicz et al. 1977).

The Southern furnace takes its’ name from the geographical location of examples found so far. The earliest known visual representation of a glass furnace is found within an eleventh-century manuscript stored in the library of Monte Cassino, entitled De Universo and written by Hrabanus Maurus (Schenk Zu Schweinsberg 1963). The details of the furnace are not extremely clear, although it may resemble the San Vincenzo kiln in that the drawing appears to portray an extension to the main kiln, similar to the subsidiary hearths.

The layout of the San Vincenzo glass kiln suggests that it may have functioned in the same way as the “Northern” type of furnace, where heat from the central part of the structure is transmitted laterally to subsidiary furnaces constructed on the same level. In this way, the lateral hearths could be used interchangeably for the fritting, founding and annealing processes. Northern furnaces dating to the ninth century are extremely rare: a sixth to ninth century example is known from Glastonbury in southern England (Charleston 1978, p. 22) and four, ninth-century furnaces were excavated at Nitra in Slovakia (Hedová 1965). The contemporary examples have oval ground-plans although it is possible that the significant element is the lateral transfer of heat rather than the actual shape of the kiln. The construction and use of this type of furnace was described in detail by Theophilus in his second book, during the twelfth century, although he seems to suggest a rectangular ground-plan. Perhaps more relevant is a tripartite glass furnace described in a twelfth or thirteenth-century manuscript written by Eracus (Merrifield 1967). The furnace is described as having a central hollow for the fire and three small compartments or “archae” with windows: a large middle arch for founding and working, with a window on each side; a smaller, right hand arch for the annealing of finished vessels and a left hand arch for fritting and for the heating or pot-arching of crucibles.

Analysis of the immense quantities of glass from the temporary workshop has shown that both window glass and vessel glass was being manufactured (Dell’Acqua 1995; Stevenson, forthcoming). The wide range of vessel types included oil lamps with vertical handles, bowls, jars, flasks,
dishes and drinking vessels. The glass waste assemblage demonstrates that a wide range of decorative techniques were employed, including «decorative flashing, festooning of coloured trails and the application of trailed thread and filigrana» (Stevenson, forthcoming). The glass kilns represent the final phase of industrial activity in the temporary workshops, before the construction of the atrium began. After the demolition of the kilns, the area was levelled with building debris and clay. A sequence of later post-holes and mortar mixers are associated with the construction of the Eastwork above the level of the temporary workshops.

THE DISCOVERY OF A PISÉ COMPLEX ASSOCIATED WITH THE BUILDERS’ YARD

Excavations within the area of the builders’ yard suggest that the temporary workshops cover a surface area in the region of 200 square metres. Recent excavations to the south of the atrium imply that the builders’ yard may have formed part of a much larger and earlier complex than previously believed: a series of clay-bonded or pisé structures (Francovich et al. 1980) which also pre-date the construction of the basilica follow a unique alignment which encroaches diagonally westwards upon the southern nave of the church (Hodges et al. 1995). The same alignment may be represented by the builders’ yard, although the positioning of the later atrium above part of the complex makes this difficult to determine with any certainty. Although the pisé buildings provide no evidence of industrial activity, they are provisionally interpreted as storage or processing rooms or perhaps living quarters, associated with the builders’ yard and the preparations for the construction of the basilica. If our assumptions are correct, a huge pre-basilican complex of over 600 metres is represented, which in addition, almost certainly extends to the north and west, below the later atrium. The alignment and stratigraphic sequence of the early buildings suggests that they were conceived well before the construction of the church in the late eighth century. They had all certainly gone out of use by the 820’s, when the addition of the funerary atrium meant that the workshop structures were demolished and the existing pisé buildings were re-aligned to form part of abbot Epyphanius’ new monastic plan (Fig. 3).

K.F.

CONCLUSIONS

In its extent and ambition, the programme initiated by Joshua at San Vincenzo at the end of the eighth century compares with the transformation of a number of monasteries in the Frankish kingdoms under the Carolingians. The scale of the enterprise invested in the building of San Vincenzo Maggiore has been compared with the megalomaniacal ambitions of Abbot Ratgar at Fulda (DeLogu et al. 1996, p. 17). The buildings of the new monastery employ many aspects current in Carolingian architecture: the vast corridors linking the liturgical and industrial heart of the monastery to the cloisters and the great monastic refectory are likened to those of Charlemagne’s own imperial-palace complex at Aachen; arcaded corridors hundreds of metres in length connected the three principle churches of Saint-Riquier (Centula) under Angilbert (DeLogu et al. pp. 9-10; Heitz 1980, 64ff., fig. 45, 51ff., fig. 36). Similarly the organization of the topography of the ninth-century monastery may be revealed to have been determined by similar principles employed by the author of the Plan of St Gall, which Jacobsen has shown to represent a palimpsest of Carolingian planning (DeLogu et al. 1996, p. 8; Jacobsen 1992).

Closer examination of the archaeology of Joshua’s plan for a ninth-century monastic city at San Vincenzo confirms the nature of its ethos revealed by comparison with Carolingian schemes of the same period. The archaeology of the temporary workshops appears to exhibit the same outlines as the pattern of planning and organization described by contemporary and near-contemporary accounts of imperial building projects in the Frankish realm. In his Life of the emperor, Notker, the stammering toothless monk of St Gall, describes the planning and preconception of building programmes under Charlemagne: «He (i.e. Charlemagne) conceived the idea of constructing on his native soil and according to his own plan a cathedral which should be finer than the ancient buildings of the Romans … to help him in this he summoned from all the lands beyond the sea architects and workmen skilled in every relevant art. He placed them in charge of a certain abbot who was most experienced in this kind of work.» (I, c. 27). Here Notker seems to be describing a recurrent and characteristic formula of building projects in the later part of the eighth and ninth centuries in the Carolingian world. An initiative takes first...
the form of a plan devised by a member of the élite. The services of architects and craftsmen are procured as an essential part of the plan, and placed under the supervision of an appointed and suitably experienced individual of élite status, in this case an abbot. Of the building of the imperial palace at Aachen we read of the appointment of a superintendent of the royal works under Abbot Eginhard, «a man in everything most learned» (Gesta abb. Fontannell. c. 17), and Gerward, the palace librarian (Einhard, Translatio S. Marcellini et Petri iv, 8).

The de novo building or thorough restructuring of monasteries, churches and palace buildings throughout the period brought with it a wide-ranging demand for the provision of new fixtures and fittings. While columns and other structural or sculptural elements may have been removed from derelict Roman buildings, certain aspects of the fitting out of empty shells of new buildings had to be provided for on site as these were constructed. The temporary workshops at San Vincenzo reveal the provision made by Joshua and his architect for the production of vast quantities of material destined for the new abbey-church. Once the building had been worked out and the site prepared, the construction of San Vincenzo Maggiore commenced at its west end. As an essential and integral aspect of this programme of works, an area to the east was occupied by temporary workshops to provide the necessary tiles, glass and metalwork and finally for the mixing of mortar as building advanced over the site.

The documentary sources indicate and emphasise the provision and activity of craftsmen in these schemes. The integral role of craft production in Carolingian plans is expressed by Einhard in his version of the life of Charlemagne: «He built the basilica at Aachen with the greatest beauty and adorned it with candelabra, and choir-screens, and doors of solid bronze.» (Vita Karoli, c. 17, 26). The same observation is made by the author of the Chronicon Moissiacense (a. 796). Our conclusions remain guarded while the research is in its preliminary stages. However, the assessment emerging from the results of the excavation of the temporary workshops at San Vincenzo al Volturno appears to lend archaeological substance to the understanding of the dynamics of the great architectural schemes of the Carolingian Renaissance which previously have depended solely upon a few precious documentary accounts.

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