CONTENTS

ARTICLES

Written in Stone: The impact of the properties of quarried stone on the design of medieval sculpture ........................................ 1
by Janet Snyder

Oh Master, You're Wonderful! The Problem of Labor in the Ornamental Sculpture of the Chartres Royal Portal ........................................................ 6
by Vibeke Olson

Dendrochronology for Medieval Studies ...................................................... 13
by Lynn T. Courtenay

REVIEWS

Angevin Architecture in the Kingdom of Naples: a review of recent studies ........................................................................ 18
by Michael T. Davis

CONFERENCE NOTES

AVISTA Sessions at Thirty-eighth Medieval Congress, 2003
Program and abstracts of papers ............................................................... 21
AVISTA Sessions at Thirty-seventh Medieval Congress, 2002
Program and abstracts of papers ............................................................... 25
AVISTA Sessions at the Leeds Medieval Conference, 2002
Program and abstracts of papers ............................................................. 28

BULLETIN BOARD........................................................... 31

AVISTA Business Meeting, 2002 ............................................................... 32

Notes for Contributors ................................................................. 33

Editorial Board and Membership Application ....................................... 34
THE IMPACT OF THE PROPERTIES OF QUARRIED STONE ON THE DESIGN OF MEDIEVAL SCULPTURE

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No clue can be overlooked in the study of medieval sculpture. The investigation of the impact of the properties of quarried stone on the design of twelfth-century architectural sculpture has unfolded like the plot of a mystery novel. In her study of ornamental colonnette sculpture Vibeke Olson has discovered evidence for the sequence of labor that created the ornamental sculpture in west façade of Chartres Cathedral. Recognizing that surface finish offers clues of successive stages of work, she suggests that the different "hands" apparent in portal sculpture might actually be the product of the last artist/mason (ymagier) working on the carving rather than of individual geniuses working from start to finish on a single sculpture. At Saint-Ayoul in Provens I have observed evidence of the penultimate and ultimate stages of carving, extending Olson's discovery concerning workshop practice to the column-figure sculptures.

In the more than thirty church portal sculpture programs installed in northern France between the 1130s and the 1160s, a stunning new feature was the inclusion of rows of over-life-size column-figures elegantly dressed in contemporary court clothing. The language of dress conveys part of the iconographical meaning conveyed by these coherent programs of sculpture. The column-figures appear to be garbed as contemporary matrons, young ladies, courtiers, knights, clerics, dukes, and consecrated monks. United by the fashionable costumes they wear, the column-figures were carved by various ymagiers who used a type of limestone found only in Paris, liais de Paris.

One of the most baffling aspects of these mid-twelfth-century French ensembles is the contradiction between the similarities of form and the pronounced differences in finished detail while essentially no written documentation of the processes of the design and carving of stone sculpture exists, clues to workshop practice are revealed by the sculpture. Once the ymagiers chose to work with liais de Paris for sculpture, the specific physical properties of this limestone--its fine grain, hardness, and the dimensions of the beds in the quarries--along with its rarity and expense, shaped portal design and dictated aspects of column-figure execution. This essay will look again at the hard evidence and analyze its implications.

THE CHARACTERISTICS OF QUARRIED BLOCKS OF LIAIS PARIS

The architectural envelope of churches across northern France was made of local limestone that was difficult to cut into blocks and was even more difficult to sculpt, so a different kind of stone was required for the production of detailed architectural sculpture. Liais de Paris, a fine and hard limestone that is very resistant to weathering, was acquired from quarries in the environs of Paris. Among the beds of lutetian limestone exploited in the ancient quarries of the Parisian region during the Middle Ages, the liais bed is the finest and hardest: its hardness results from its microsparitic composition in which the pores are replaced by fine crystals of calcite. These qualities of the liais de Paris affected both the techniques employed by its carvers and the extraordinary quality of the carving that achieved a precision of the detail previously seen only in small ivory or gold sculpture. The advantages of liais de Paris must have been evident to sculptors across northern France where it was in constant demand: it was used for the column-figures installed in the jambs of Saint-Denis and of Parisian churches; it was exported for the column-figures of the Royal Portal of Chartres Cathedral and it has been recognized at Étampes, Auxerre, Saint-Maur-des-Fossés, Saint-Ayoul of Provins, Saint-Loup-de-Naud, Donnemarie-en-Montois, Meaux and the church at Rampillon. The Limestone Sculpture Provenance Project has been able...
to identify quarry sources for liais sculpture with reasonable certainty through the process of characterization by neutron activation analysis and multivariate statistics.

The blocks of liais de Paris from which the column-figures were carved were set en délit (placed vertically) as part of the façade walls of the portal jambs. For this study, I measured the plans of the stepped embrasures, that is, the sides of the bases of the column-figure blocks, at twenty-four extant twelfth-century church portals. The stepped embrasures of the west façades of Saint-Denis and of Chartres Cathedral show no regular pattern in their dimensions, but at other contemporary buildings where portal sculpture programs were installed, there are striking similarities in their plan dimensions. The width and depth of the en délit blocks arranged as contiguous steps along the doorway embrasures consistently measure between 34 and 37 cm, even when portals have very different proportions. That is, despite significant variations in the height of the finished column-figures, the height of the figures above the ground level, the width or height of the door opening, or whether or not there was a trumeau supporting the lintel, the modular space left for the base of each column-figure conforms within a few centimeters. One dimension in each block’s plan measures less than 36.5 cm. This standard dimension must have been determined by the thickness of the bed of liais in the old quarries of Paris, which was between 20 cm and 45 cm. The thickest beds were used for monumental sculpture, the mid-sized for colonnettes, and the beds of 20 cm and less served for flooring and tombstones. While the length of quarried pieces might vary considerably, and the width of a block might vary a bit according to choices taken as it was removed from the quarry (broader pieces were required for lintels or tympanums), the depth of the beds in the quarries must have contributed to a standardization of the dimensions of church portal construction. The possible thickness of stone limited and therefore determined a standardization of base dimensions for the sculpture and the steps of portal jambs. Distinctions between the “foot” used in Paris or Amiens or elsewhere in France cannot explain my findings that the actual dimensions in centimeters coincide in Paris, Burgundy, and Picardy.9

TRANSPORTATION AND CHANTIER PRAXIS

Transportation costs constituted one of the heaviest burdens on the budget of a construction project, and since shipping could double the price of stone, an effort was made to economize by rough-cutting blocks at the quarry.10 Whenever possible, water routes were chosen to haul materials to the building site, and we can well imagine loads of liais de Paris arriving in the solid little shallow-draft barges used for agricultural transport from neolithic times to the seventeenth century. Among the extant examples of French river cargo vessels between 4 and 15 meters long published by Éric Rieth is the one found at Orlac made of lumber cut between 1021 and 1042, which could have been loaded to pass 10 centimeters beneath bridges, carrying up to 8.2 metric tons.11 Annie Blanc and Claude Lorenz mention that capitals from the central vessel of the Paris Cathedral choir, made of cliquart limestone and measuring 83 cm high by 1.55 m wide, weigh approximately three tons each.12 The volume of such a capital would then be about 1,994 cubic meters. From this it is possible to suppose that a boat with an 8.2 ton capacity could carry roughly 5.45 cubic meters of stone. Translating this into the long narrow pieces of liais de Paris used for columns figures by assuming an average 35 cm width for the slab, a barge could be loaded with a gross running length of 44.5 m. Assuming that each block was cut into 2.5 meter sections, as many as seventeen roughed-out blocks for column-figures might be packed into each shipment. Delivery of the “kits” of portal figures for such modest programs as Étampes or Provins would thus have been a relatively expeditious operation.

Since Wilhelm Vöge’s assessment published in the 1890s, architectural sculpture produced during the twelfth century has been attributed to ymagiers working as individual artists, called “Headmaster,” “assistant”, and so on.13 Modern scholars concur that ymagiers must have been aware of contemporary developments in portal design at regional churches—and that the same ymagier worked on the figures of Mary as Throne of Wisdom at Chartres and at Notre-Dame in Paris—and that they also might have met each other in the quarries.14 It seems nearly certain that in twelfth-century Burgundy particular types of capitals were fabricated in series in an atelier and then were sent to churches during the course of their construction.15 The substantial weight and size of column-figures in northern France disallow the same practice. As much as possible, blocks might have been reduced in weight before shipping, with rough cuts made at the quarry before shipment to the onsite chantier where the finished details were made after installation.16
Figures 1, 2, 3, and 4 place column-figures from Étampes side-by-side as they never could stand in situ. I have assembled this group to suggest the possible use of standard modular “blanks”: that is, blocks of stone that might have been ordered from the quarries and roughly sketched into styles to be customized, not unlike the way felt hats can be ordered today. Although all four have their hands in similar attitudes, all but “Saint Peter” (Fig. 4) have one high elbow and the attribute in the center. This composition suggests that the ymagiers might have begun the three column-figures on the left with roughed blanks of liais de Paris of the same shape. I propose that formal similarities combine with dissimilar finished details to suggest that roughed-out stone forms had been delivered to the church-side lodges to be completed in place by the finishing ymagier. Such a procedure conforms to Vibeke Olson’s analysis of the three steps of the working process for the production of ornamental colonnettes: the layout of the design, blocking out of basic forms, and detailing.17

CARVING: THE PENULTIMATE AND ULTIMATE STAGES

The dissimilar finished details on similar forms can be observed in the three women column-figures whose mantles are fastened on the right shoulder from Saint-Ayoul in Provins (Fig. 5), Saint-Germain-des-Pré (Fig. 6), and on the right doorway of the west façade at Chartres Cathedral (Fig. 7). The general form of each is the same: each is dressed in the two-piece bliaut gironée and mantle; each exhibits a severely bent right wrist; each left hand lifts the hem of the mantle to hip level, and each wears knee-length braided hair. The finished details differ: these appear to be by different “hands” working within the same fashion vocabulary. The standard rough module for a type of column-figure was delivered to the chantier, furnished with individual details of contemporary clothing, and then installed: at Saint-Germain-des-Prés the crown was set over a square veil and double-braids, while at Chartres the crown appears without a veil but with awkward, bumpy braids. Vertical lines cross the neckline at Saint-Germain, while a straight pin fastens the chemise throat opening at Chartres. At Chartres the fullness of the skirt coils and recoils like yards of ribbon candy, but at Saint-Germain, the fine bliaut gironée hem ends well above two layers of undergarment skirt hems, and at Saint-Ayoul, the finely-pleated skirt ends just above the shoes.

A precious illustration of workshop practice appears in the thirteenth-century Saint-Chéron window at Chartres. Arched openings shelter two pairs of ymagiers at work with different tools (mallet and broad chisel or pointed chisel) during the different stages in making column-figure sculpture. In the right panel, the column-figure is not as finished as in the left panel where facial features and other details appear. This window may illustrate two stages in the process of carving a single column-figure. Peter Kurmann has speculated that for thirteenth-century sculpture at Reims, individual genius-artist-masons recomposed individual sculptures rather than copying models as they directed their teams of workers.18 Alternatively, it may represent carvers working in the lodge sequentially as Olson, in her study of ornamental colonnette sculpture, suggests. At the church of Saint-Ayoul in Provins, I have found evidence in the similarities between the surface finishing of various column-figures that demonstrates that the sculptors followed a similar sequential workshop practice. Let us look at the details more closely.

The courtly dress of most women column-figure sculptures includes decorative knotted belts. A comparison of carved fingers, belts and waistbands of the two women at Saint-Ayoul illustrates the penultimate and ultimate steps in the finishing of column-figure sculpture. In the left jamb figure of a woman (Fig. 8), the hand is a blocky cutout, and the border of the mantle, the belt and the connection between skirt and bodice are thick blank forms, with the skirt textile represented in heavy, tubular pleats. This is the equivalent of the chamfered vines of the ornamental colonnettes discussed by Olson. On the right jamb (Fig. 9), the woman’s open mantle and her gown are articulated in fine detail. Although the fine linen of the hanging sleeves on the left jamb woman has been carved in pointed
grooves indicating the crinkled linen, the torso linen is smooth; this figure was set in place while at the penultimate stage, just before the final detailing. Actually, since twelfth-century sculpture would have been polychromed, the details of trim might barely have been missed, but the roughly blocked out hand is hard to overlook. This unfinished state is more clearly evident when compared with the more precisely detailed figure on the right jamb that clearly illustrates the ultimate stage of carving.

In the completed work, the entire bodice of the *bliaut girone* has horizontal puckers while the skirt has slightly crisper vertical pleats beneath the knotted cords of the belt. The right jamb waistband was finished in alternating triangular, corded fields. A comparison of these two figures carved in the same workshop demonstrates that the reduction in the depth of the waistband corresponds to a quantity of stone removed during the finishing of the sculpture.

This kind of finishing characterizes the majority of column-figure women sculpted during the mid-twelfth-century. Graceful hands with fine long fingers support a book or scroll (Figs. 10, 12), while the clothing reflects contemporary fashions in court dress in which a delicately worked waist band covers the transition between bodice and skirt. Usually the doubly-wrapped belt knot cradles the lower torso. The gently rounded bellies of female figures are emphasized at doorways from the churches of Chartres (Figs. 7, 10, 11), Saint-Loup-de-Naud (Fig. 12), Étampes (Fig. 3), Saint-Germain des Prés, Notre-Dame of Corbeil, Saint-Denis, and at Le Mans. The fully-carved hands and garments of these sculptures illustrate the ultimate stage of twelfth-century workshop practice.

Geologists have identified the stone for column-figures both in Paris and outside the capital through petrographic analysis as a particular lutetian limestone, the *liais de Paris.* The characteristics of this stone, its availability and dimensions each played a role in shaping the design of church portal sculpture at the beginning of the Gothic period. A close examination of the material used for the sculpture has led to this reexamination of sculptural praxis during the twelfth century. Despite a dearth of written documentation, the architectural sculpture unlocks the mystery and reveals itself as a self-explanatory text. The messages lie encoded in the form, the finish and the material of the sculpture.

NOTES


1. Vibeke Olson, *Oh Master, You are Wonderful! The Problem of Labor in the Ornamental Sculpture of the Chartres Royal Portal* in this issue of *AFJ.*


3. For their encouragement of my search for answers, I would like to thank Annie Blanc, William Clark, Michael Davis, Lore Holmes, Danielle Johnson, Evie Lane, Charles Little, Vibeke Olson, Mark Viré, and Georgia Wright. This work was supported in part through West Virginia University Senate Research Grants and the Limestone Sculpture Provenance Project.
4. Olson, *Oh Master* (as in n.1); previous investigations are cited below in n.9.


8. Blanc and Lorenz, *Observations* (as in n. 5): 136. “Le portail Sainte Anne: Le tympan et les voussures sont en liais de Paris. Les éléments consituants sont des dalles de grande dimensions. Pour les ébrasements, de chaque côté, à la hauteur des yeux, le décor de colonnettes est taillé sur deux dalles de liais aux dimensions imposantes: 3,4 m de long, 1,25 m de hauteur, 0,35 m environ d'épaisseur.”


15. Other examples of such practice include Late Antique marble capitals dispersed throughout France, altar tables of the Narbonne region transported for long distances to be placed in sanctuaries which had need of them, and later baptismal fonts and funeral stones dispatched as far as England. Tournai sculptures, Mosan and Limoges enamels were scattered all over Europe, and painted or fabulously carved wood retables were sent even to Scandinavian countries. If, as Francis Salet suggests, Romanesque capitals might be included in this list of works of art from the Middle Ages that can be properly called commercial, surely the serial production of sculpted elements in liais de Paris fits that category, too. Paul Deschamps, *La sculpture française à l'époque romane. Onzième et douzième siècles* (Florence-Paris, 1930): 39-40, pl. 40C and D (Valence), cited in Francis Salet, *Cluny et Vézelay, L'oeuvre des sculpteurs* (Paris, 1995): 143.


17. Olson, *Oh Master* (as in n.1).


OH MASTER, YOU'RE WONDERFUL!

THE PROBLEM OF LABOR IN THE
ORNAMENTAL SCULPTURE OF THE CHARTRES
ROYAL PORTAL*

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Perhaps the greatest obstacle to the study of production and individual contribution on the royal portal of Chartres Cathedral is what I term the master problem. The labeling and division of anonymous individuals into masters and assistants carries with it hierarchical connotations, not only in terms of quality, but in terms of labor as well. For instance, the label Headmaster implies not only that he was the best artist at work on the façade, but the genius behind the planning and execution of the final design as well as the innovator of the Gothic style in sculpture. The essential problem with this theory is that no concrete evidence exists to back up such a claim; nor is there any conclusive way of determining what was, indeed, considered quality work to a twelfth-century viewer or patron. Assumptions are made, based on the placement and size of an individual's images, regarding the quality of the individual's work and their position within the workshop. Consequently, little attention is then given to the ornamental sculpture tucked away behind and around the programmatic sculpture and how it relates to the work of these so-called masters. This focus may be due in part to its decorative nature, or perhaps to its marginal placement on the façade. Regardless, it undoubtedly stems from a nineteenth-century Romantic notion of artistic genius and the application of a Renaissance-style division of labor into masters and assistants; theories which have, to varying degrees, become integral to the discourse on medieval sculpture, particularly in the case of Chartres' west façade.

Beginning with Wilhelm Vöge in 1894, the scholarship on Chartres west has industriously conjured a plethora of Masters. Pride of place is held by the infamous Headmaster whose works have been identified as those in the center of the portal followed by the lesser works of assistants. To date, at least seventeen different masters and assistants have been identified as having been involved in the production of the Chartres sculpture. Focus on the Headmaster and the authorship of the programmatic sculpture however, has marginalized the ornamental sculpture of the façade, and left an incomplete picture of the labor process and organization involved in the creation of the portal. We are still left with many open questions. For instance, what is the distribution of an individual's ornamental work on the façade, and what might its pattern mean in terms of the façade's production? What was the system of dividing the labor among the sculptors and/or the type of work they produced? And what does an individual's specific role in the production imply about the nature of collaboration on this project? In this paper, I will address these questions by focusing on the ornamented colonnettes interspersed behind and between the jamb statues of the façade. The sixteen colonnettes, each approximately 3.5m in height, are made up of forty individual detached shafts which vary in length from 11 to 250cm (Figs.5-8). Each of the forty shafts is carved with a distinct motif which, as will be discussed below, appears to be the work of several individuals. By examining individual contributions to the ornamental rather than the often studied programmatic sculpture, I will address the issue of the division of labor, vis-à-vis the responsibilities of an individual in the process of artistic creation and collaboration.

Although few attempts have been made in previous scholarship to address the authorship of the colonnettes, Whitney Stoddard in his monumental study of the sculptors of the west portal posits three possible solutions as to how the ornament may have been carved and distributed.3 His first hypothesis is that the ornament was sculpted en masse by specialists...
in the workshop, and that each of the main sculptors selected colonnettes to frame his jamb statues – the Headmaster selecting first and his assistants last. The second option he proposes is that each of the sculptors had assistants who worked with them on their splays, and his third possible solution to the problem is that each of the main sculptors of the statue-columns sculpted the ornament of his individual splay himself. He concludes by stating that, "the third option appears to be the strongest, since the crudely carved colonnettes are all found on L.P.R and R.P.L splays, by the two assistants of the Headmaster, in which the statue-columns reveal a decline in quality ..."

Although one of Stoddard's options will indeed prove valid, he offers us no explanation for his choice other than references to quality; high quality work an index of a master and lesser quality that of assistants. No attempt is made to further analyze the ornament of the shafts or to probe deeper into aspects of their production and placement in order to support his hypothesis. Thus, in order to fully understand the ornamental shafts in relation to the programmatic sculpture, an in-depth analysis of the individuals involved in the production of the colonnettes is called for. This will give further insight regarding the individuals involved, and how the distribution of work may or may not reflect a division of labor among the individuals involved in the creation of the façade, and/or a distinction of sculptural categories.

**Methodology**

The application of traditional Morellian connoisseurship is generally used to trace an artistic personality throughout his/her career, or to attribute an unknown work to a known individual and has led to an art history of style. This circular approach to the study of art eventually led to the dismissal of stylistic analysis as a viable methodology. I would suggest, however, that perhaps it was not necessarily the methodology that was problematic, but the questions that were being asked. It is with the goal of examining the larger questions of labor practice and workshop organization rather than with the intent of tracing stylistic trends and individual genius that I use a Morellian-based analysis in this paper. To accomplish this, I consider the work by closely analyzing and categorizing the ornamental details of the colonnettes that leads to the identification and grouping of hands involved in the production of the ornament. Determination is then made regarding the creative responsibilities of the individuals.

Let us begin the analysis by grouping the field of forty shafts by their largest common denominator – the vine form. In my examination of these vine forms, I expected that an individual sculptor, no matter how large and varied his decorative repertory, tended to prefer and repeat certain details. Marks of individuality appear, for instance, in the treatment of the pearls that articulate the central axis along many of the vines on the colonnettes. In most cases, the pearl motif along the center of the vine is treated as a continuous channel-set motif. Distinctions that may indicate individual hands were found, however, when I studied the treatment of the motif further. In one group of shafts (group 1), the pearls are bordered directly on either side by the thin vertical lip of the fascia (Fig. 1). Occasionally the surface of the fascia is treated as a shallow cavetto, as for example above the head of the centaur in figure 2, but otherwise it is a smooth plane angling out from the central line of pearls. In either case, the outer edges of the fascia are bordered by a continuous, fine fillet. The outer edges of the vine meet the fillet at an angle and the two are separated by a shallow chamfer. The areas in which one stem branches off another are treated as a series of chamfered ridges which fan from the upper stem out over the lower stem. This treatment can be contrasted with another group (group 2) in which the pearls are edged by thin rounded fillets rather than being directly bordered by the vertical lip of the fascia, as in the first group (Figs. 3-4). These fillets are then flanked by the fascia which angles out in a smooth plane to meet the fillet edging the vine. Like the vines of the first group, the outer fillet is differentiated from the fascia by a shallow chamfer.

**The Distribution**

The grouping of criteria allows the contributions to be mapped, resulting in a distributional diagram which indicates that more than one artist was responsible for carving the forty sections of shafting (Fig. 5). It also indicates that the carvers were not necessarily responsible for an equal share of the shafts – the group 1 carver(s) appear to have been responsible for fifteen of the shaft sections and the group 2 carver(s) seem to have carved eight of the shafts. In total, this set of sculptors may have been responsible for just over half of the shafts (a grand total of twenty-three) while other sculptors appear to have worked on the remaining seventeen shafts.

The colonnette shafts are not location-specific elements – they are standardized not only in their diameter but also in their composition; that is to say that each has its own base and astragal, therefore avoiding the problem of image continuity between the shafts. Also, since the ornament has no linear narrative or continuous vertical motif to maintain, the shafts can conceivably be placed in any order. The pattern on the diagram suggests, however, that the placement of the individual shafts does not appear to be totally random. The group 1 shaft sections tend to be predominantly clustered in the left portal splays and the group 2 shafts are found largely in the central portal splays. However, in both cases, their shafts can be found in splays outside of the ones in which they are clustered. In light of this information, we can reconsider Stoddard's hypotheses regarding the problem of the production of the ornament. It would appear, based on the distribution of the shafts, that his conclusion stating "each of the five sculptors of the statue-columns sculpted the ornament of his individual splay" is no longer a valid option. Stoddard's first hypothesis, however, still remains plausible: that the ornament was sculpted en masse by specialists and each of the main sculptors then selected colonnettes to frame his jamb statues, with the Headmaster choosing first and his assistants last. I concur with Stoddard that the shafts were mass-produced, though a hierarchical process of selection cannot be verified.
The Sculptural Process

In order to fully address the issue of labor in the ornamental sculpture of the portal, beyond the Morellian identification of individual hands, I shift focus to the three partially finished shafts of the façade (Figs. 6-8). These partially completed shafts are significant because their unfinished state provides the rare opportunity to study both the design and labor processes utilized in their production. Past studies of unfinished sculpture have revealed important information about the twelfth-century sculptural process. By analyzing the conclusions found in these studies and contrasting them with what can be observed in the unfinished sculpture at Chartres, I will show that the working method of the Chartres sculptors may have differed from that in other, smaller projects.

In the Crosby relief at Saint-Denis, for example, an unfinished section remains along the right-hand edge of the piece which may give us an idea of the steps involved in the carving process (Fig. 9). To begin with, the basic form of the image is inscribed along the surface of the stone, as can be seen on the bottom right where the foliate motif appears etched in abstract shapes. The next step is the blocking out of the image in relief which is seen in the center, followed by the definition of the form with the added details found at the top left end. Thus, after having fully etched the design onto the edge of the slab, the work appears to have progressed systematically from top to bottom, or rather from left to right as the block would most likely have been worked with the carved apostle panel facing down to avoid accidental marring of the completed figures. In this relief then the three steps of the working process – the etching of the design onto the stone, the blocking and undercutting of the image, and finally the addition of detail – as well as the directional movement can still be seen. This same process has also been identified on the reverse of the Last Supper lintel at Saint-Germain-des-Prés in Paris: the etched image appears at the right, the further blocking and undercutting is found in the center of the panel, and the addition of details was begun at the left, again establishing a distinct three-step sequence as well as a consistent directional movement from left to right. Since all three steps of the process can be seen in both of these pieces – the final details have already been added to the extreme left ends before the entire motif has been fully blocked out – I would conclude that this was the standard process of labor used in the carving of single-slab flat reliefs. I would also hypothesize that one individual was likely responsible for all aspects of the labor on each piece. In each case, the panel appears too small to have had more than one sculptor working on it at a time and it would seem unlikely that the work was done on a segment-by-segment basis, stopping and starting at each new segment of the design. In a larger and more complex project like that of Chartres west, however, a somewhat different approach may have taken place.

At Chartres, a similar analysis of unfinished work can be undertaken in the three partially completed shafts. Again, it is in these unfinished areas that visual documentation of the working methods of the sculptors can be found. The compositions on each of the three Chartres shafts have been completely blocked into the stone in full depth relief from bottom to top; the etching process presumably having been done in a prior phase. The next step in the carving process, that of detailing the design – the addition of facial features, peeling and definition of foliate forms – has been interrupted at some point before completion on each of these shafts. The result is a group of shafts in which the lower portions are fully completed and the upper sections remain only partially completed; blocked, but not yet detailed. What is interesting to note in the unfinished portions is that the relationships between forms have already been fully rendered. This level of detail is evident in all of the unfinished registers of each of the shafts, and a convention of smooth planes with angled surface relationships appears to be standard throughout the unfinished portions of the shafts as shown in the following examples.

Right portal left jamb, second colonnette from the door, second shaft section from the bottom (RPL2b)

In RPL2b, the composition of the entire colonnette has been blocked in full relief with the basic forms – in this case the signs of the zodiac and labors of the months (Figs. 7, 10, 11). Only the lower two sections, however, have undergone the final stages of carving with the addition of
facial features, drapery folds, architectural and foliate details (Fig. 10). The upper eight registers remain in the form of deeply undercut and fully formed images, yet devoid of surface articulation. For example, in the seventh register (July), the figure of a man harvesting has been slightly worked to show the positioning of hair, nose and ear, as well as indicating the knuckles of the hand gripping a tool (Fig 11). The relationships of forms to one another have been fully integrated into this stage of the carving and are evident in the manner in which the edge of the garment has been described over and around the figure’s legs and wrist, as has the brim of the hat over and around the head. In the tree, branches have been defined and the relationship of leaves to stem has also been determined. The branches have been treated as two smooth chamfered surfaces that meet at a central raised point, and the edges of the clothing are treated as chamfered angles.

Right portal right jamb, second colonnette from the door, third shaft section from the bottom (RPR2c)

Similarly, in RPR2c attributed to group 1, only the lower portions of the shaft have been completed with full surface articulation such as facial features and drapery folds, and the vine forms have been completed with pearls (Figs. 8, 12, 13). In the bottom section of this shaft, the left-hand figure is fully completed as is the centaur in the center. However, the figure to the right remains only partially completed (Fig. 12). In the next register, the vine and leaf forms to the left have also been fully completed, but the leaf form, vine and figure to the right remain incomplete. This is particularly noticeable in the vine form to the right above the clasp. The section of vine between the clasp and the foot of the figure above has been fully rendered with the surface articulation of channel-set pearls, whereas the section of vine above the foot remains as two unarticulated smooth planes with a raised central point. This indicates that the directional movement of the work proceeded not only from bottom to top, but from left to right as well, in the manner of the Crosby relief and the Saint-Germain lintel. As can be seen from these transitions, the nature of the change from unfinished to finished areas is predominantly one of surface changes. For instance, the definition of the vine form will be completely altered with the addition of the surface details as indicated by the finished areas. The central portion of the vine will be changed from a raised point to a surface flattened by the addition of the pearls, and the edge of the vine will be changed by the carving of a thin fillet, altering the abrupt chamfered edge. Once again in the unfinished areas, the relationships of the forms have been defined. For instance, the quadruped at the top of the shaft overlaps in front of the foliage, whereas the bird is situated behind the vine (Fig. 13). The haunch of the quadruped has been defined as a raised surface and the surface of his left (facing) foreleg is carved in higher relief than his right foreleg. In the figure of the bird, the wing is indicated as a separate mass in higher relief than the body and the leg is also indicated as a distinct form separate from the body. As in RPL2b above, the vines have been treated as smooth chamfered surfaces that meet at a raised central point, and the same treatment is carried over into the unfinished astragal.

Central portal left jamb, first colonnette from the door, first shaft section from the bottom (CPL1a)

Shaft CPL1a, by the group 2 sculptor, has also been fully blocked in relief from bottom to top, with all but the upper two registers having been fully rendered (Figs. 4, 6, 14). In the carving of the detail on this shaft, no distinction was made between the different types of decoration. For example, the decorative band which divides this shaft into registers, has received articulation up to the same point as the figural forms, indicating the same carver was most likely responsible for the detailing of foliate, figural, and purely decorative forms (Fig. 6). Like the other unfinished shafts, the relationship of forms to one another has already been articulat-ed in the unfinished registers. For example, in the unfinished seated figure, the nature of the relief indicates that the left leg is placed in front of the vine and the right leg behind the vine (Fig. 14). It is also clear that the left hand is to be placed on top of the thigh and the right hand on top of the vine. Additionally, a branch with a pinecone droops over the right arm, and another leaf folds over the top loop of the vine. As in the other shafts, the unfinished vines have been treated as chamfered forms meeting at a central raised point. The unfinished portion of the decorative band, however, is simply a flat surface with no indication as to the decorative scheme to be carved on it (Figs. 6, 14).
IMPLICATIONS

From the state of completion found in the three unfinished colonnettes, four compelling conclusions may be drawn. First, the colonnettes appear to have been completed in stages as follows: the etching of the design into the stone, the blocking out of the image in relief, and then the final detailing of the composition. It is only in this final stage, the finishing detail, that the shafts exhibit identifiable marks of individual authorship. Second, it appears that the work progressed in a consistent directional manner, from bottom to top and from left to right, as in the Crosby relief or the Saint-Germain lintel. Third, in the finishing of the shafts, no distinction in the carving process appears to have been made between motif types; namely figures were not finished before foliage or decorative bands, or vice-versa. Rather, the cessation of labor consistently appears at some point within the continuous, directional progression of the work. All motifs were worked on simultaneously beginning at the bottom of the shaft section and advancing toward the top. And finally, although the manner of carving the relief is consistent in the three unfinished shafts, they appear to have been finished by three distinct individuals; RPR2c by the finisher who worked on the group 1 sections, CPL1a by the group 2 finisher, and RPL2b by a third finisher, implying a sense of fluidity in the production of the shaft sections. These conclusions, when considered together with the state of completion in the three unfinished shafts, point to the possibility that more than one individual may have been responsible for the carving of each shaft. That is to say, the work may have been done in an assembly line fashion with specialists—finishers, relief carvers and possibly etchers—responsible for each of the steps involved in carving the shaft sections. The carvers appear to have worked on the shaft sections as needed rather than in set groups suggesting variable relationships between carvers. Reliefs carved by a particular blocker, for instance, were not all necessarily detailed by the same finisher; it is likely that they were detailed by whichever finisher was available at the time.

Considering the amount of labor involved in carving the forty colonnette shafts, particularly in light of the intricate detail with which they are carved, it seems reasonable to posit that the labor could have been divided and shared amongst the carvers in this manner. Such a system of production was suggested by John White in a discussion of the sculptural reliefs of the façade of Orvieto. According to White, after the design had been roughed out, the work proceeded piecemeal by specialists moving from one block to the next when they had completed the portion for which they were responsible. Herein, however, lies the fundamental difference between the treatment of the unfinished sculpture at Chartres and that of Orvieto. In the reliefs of Orvieto, there are varying states of completion depending on the type of motif, whereas at Chartres the two states of completion appear not between motif types, but rather within the directional progression of the work. Although both façades may have been created in an assembly line fashion, the division of labor vis-à-vis the responsibilities of the individual specialists appear to have distinctly differed between the system of task division at Chartres in twelfth-century France and the division of labor by motif specialty in thirteenth-century Italy at Orvieto.

In closing, it cannot be concluded with any certainty that a single individual can be identified as having fully produced any of the pieces of sculpture discussed. Instead, we should posit that as many as five individuals could have had a hand in the production of each piece—the shafts were most likely reduced at the quarry before shipping to the site, someone had to have been responsible for designing the image on each shaft, the etching of the design had to be done, the image was then blocked in full relief, and the finishing details were finally added—each step potentially being assigned to a different individual. Essentially, what we consider to be an individual may just be the final step in a long and complex process. Perhaps, then, our notion of an individual, at least at Chartres West, needs to be reassessed, as it appears that an individual’s role was likely determined by the type of carving he did—etching, relief carving or detailing—rather than on his status within the workshop or the importance of the piece being carved. Instead of glorifying the virtues of unknown and unknowable masters, while at the same time propagating the cult of the medieval artist-genius, it is time to let the works speak for themselves. Our understanding of the medieval labor process has stagnated as a result of this traditional, one-sided approach to the problem. Oh master, you may indeed have been wonderful, but so too were the assembly-line workers responsible for the ornamental carving found decorating most of the twelfth-century French monuments.
Painters

6. Not all of the vine forms of the colonnettes are articulated with pearls, and those which are vary in the manner of articulation. For the sake of clarity and brevity, only those vines with central channel-set pearls will be discussed in this paper. For a full discussion which considers all the colonnettes, see Vibeke Olson, *The Ornamental Colonnettes of the Royal Portal of Chartres: Architecture and Sculpture in the Context of Design and Labor* (University of California, Santa Barbara, 2001). I wish to thank Edson Armi, Michael Davis, and Janet Snyder for their valuable comments on the manuscript in its various incarnations.

1. Wilhelm Vöge, *Anfänge des monumentalen Stiles im mittelalter. Eine Untersuchung über die erste Blütezeit des französischen Plastik* (Strasbourg, 1894) was the first to systematically identify individual hands on the portal. He was responsible for the identification of the Headmaster, the Archivolt Master, the Master of Corbeil, the Master of the Two Madonnas, the Étampes Master, the Saint-Denis Master, an unknown Master and several assistants. Alan Priest, *The Masters of the West Façade of Chartres, Art Studies* 1 (1923): 28-44, followed by adding the Master of Saint-Gilles to the list and re-naming the Master of the Two Madonnas the Master of the Angels. Adolf Katzenellenbogen, *Sculptural Programs of Chartres Cathedral* (New York, 1959) responded with an additional unknown Master and an Assistant to the Headmaster. And finally, Whitney Stoddard, *Sculptors of the West Portals of Chartres Cathedral*, (New York, 1987) has added the Étampes Master Assistant, the Saint-Denis Master Assistant, the Angel Master Assistant, Headmaster Assistant # 1, Headmaster Assistant # 2, the Lintel Master, and possibly two itinerant sculptors. C.Edson Armi, *The "Headmaster" of Chartres and the Origins of "Gothic" Sculpture* (University Park, Pennsylvania, 1993) in a reassessment of the Headmaster's origins and contributions, has re-named him the Chartres Master. French scholars, such as Marcel Aubert, *Le Portail Royal et la façade occidentale de la cathédrale de Chartres: essai sur la date de leur exécution, Bulletin monumental* 100 (1941): 177-218, on the other hand, perhaps in an attempt to separate themselves from both German and American scholarship, or perhaps in realization of the inherent faults in the master theory, tend to group the work into ateliers rather than labeling individual masters. This, however, leads to its own unique set of problems.

2. Stoddard, *Sculptors* (as in n.1) 159.

3. Ibid.

4. Regarding the production of marginal corbels, Nurith Kenaan-Kedar, *The Margins of Society in Marginal Romanesque Sculpture*, *Gesta* 31/1, 1992 (15-24): 16, notes that, "in most cases the corbel series and the official Christological programs of a given church were ... carved by the same artists and commissioned by the same patrons." Although her hypothesis is very likely correct, like Stoddard, she gives no concrete evidence to support her claim other than stating that the corbels in a number of churches "show an affinity with the official sculpture".

5. As, for example, in the work of Bernard Berenson, *The Italian Painters of the Renaissance* (Ithaca, New York, 1980).

6. Not all of the vine forms of the colonnettes are articulated with pearls, and those which are vary in the manner of articulation. For the sake of clarity and brevity, only those vines with central channel-set pearls will be discussed in this paper. For a full discussion which considers all the colonnettes, see Vibeke Olson, *The Ornamental Colonnettes of the Royal Portal of Chartres: Architecture and Sculpture in the Context of Design and Labor*, Doctoral dissertation (University of California, Santa Barbara, 2001).

7. Group I consists of the following fifteen shafts: LPL1b, LPL1c, LPL2a, LPL2b, LPL2c, LPR1b, LPR2a, LPR2b, CPL1c, CPL3b, CPR1b, CPR3b, CPR4b, RPR2b and RPR2c. A note on the numbering system: the uppercase letters refer to the portal (left, right or center) and jamb (left or right), for instance LPL refers to the left portal left jamb. This is followed by a number and lower case letter which refer to the position of the colonnette counting outward from the door and the segment of shaft listed from bottom to top; for example 1b would refer to the first colonnette from the door and the second shaft from the bottom.

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fig. 10 Chartres, Royal Portal, right portal left jamb, second colonnette from the door, detail of the second shaft from the bottom: February (photo: V. Olson)

fig. 11 Chartres, Royal Portal, right portal left jamb, second colonnette from the door, detail of the second shaft from the bottom: July (photo: V. Olson)
8. Group 2 consists of the following eight shafts: LPR2d, CPL1a, CPL1b, CPL2c, CPL3d, CPR1a and CPR3b and RPL2a.


11. Motokazu Kimata, *Les colonnettes ornées du portail royal de la cathédrale de Chartres: origines et diffusions d'un motif architectural* (thèse du 3e cycle, Université de Paris 1, 1987): 114; 124 and 291, mentions these unfinished colonnettes, though he never considers the unfinished work beyond the implication that time ran out on the project requiring the shafts be set in place before completion.

12. This may, in fact, be what is depicted in the bottom two panels of the thirteenth century Saint-Chéron window at Chartres, in which four sculptors are depicted working on two jamb-statues. In the right panel, the jamb-statue is shown in the relief stage with one carver working on it and another resting by his side. The left panel jamb-statue is shown carved in greater detail, with the addition of facial features and other articulation. Again, one carver is working on the statue while another waits beside him. Might this be a representation of sculptors awaiting their turn in the assembly line? On the production of statue columns, see Janet Snyder, *Written in Stone* in this volume. The question of carving location can also be raised in relation to the colonnettes. The forty shafts which compose the sixteen colonnettes are *en délit* shafts of liais de Paris, and were certainly reduced to size at the quarry before shipping (Olson, *The...*)
Ornamental Colonnettes, 55-83). Could the process of sculpting, perhaps etching and/or blocking, also have begun before the shafts were shipped to the building site?

13. White, Reliefs, (as in n.9): 254-302.


**DENDROCHRONOLOGY FOR MEDIEVAL STUDIES**

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Dendrochronology, or tree-ring dating, has emerged in recent decades of the twentieth century as one of the most important dating tools for a number of disciplines such as archaeology, climatology, botany, and the history of art and material culture. While there are numerous publications and informative websites concerned with the technical aspects of dendrochronology and its application, this introduction is designed as a guide for medievalists with a general interest in the subject.

Briefly stated, dendrochronology creates a statistically based calendar of tree felling dates derived from the meticulous measurement of the variation of annual growth rings. Each 'ring' represents a single year's growth. Since tree rings reflect seasonal changes, only trees from temperate and arid regions have identifiable annual rings. Species like oak, chestnut, elm, beech, juniper, and conifers produce annual rings whose width and character depend mainly on climatic conditions, such as moisture and temperature. Thus, one would expect to find similar ring patterns for the same species in wetland habitats of similar altitude and growing conditions. When measurements of the variations in the size of the annual rings have been accumulated for large numbers of trees from the same species and region, a chronology of ring widths derived from these dimensions can be established. This methodology, for "dendro dating" by means of a reference chronology was developed in the early twentieth century by A.E. Douglass who used yellow pine from ancient pueblos in Flagstaff, Arizona. Oak, however, was the premier building material for large-scale carpentry in pre-modern Europe, and early buildings have furnished a considerable amount of specimens. Oak chronologies for Europe were developed mainly in the last quarter of the twentieth century, such as: Hollstein's north German oak chronology (1980), Becker and Delorme's south German oak chronology (1978-1981); there are exceptionally long chronologies for Ireland, extended via fossil material and anchored by living trees (Bailie and Pilcher, 1977 and 1980); numerous chronologies were developed in Britain, but the sequences for oak are generally shorter, e.g. Fletcher (1977-78) and Laxton and Litton, East Midlands (1988). These tree ring chronologies, including others from Scandinavia, Holland and Belgium span most of the medieval period and have been used as the foundation oak chronologies for those developed later for Europe, including parts of France, such as the early Northern French Chronology AD 1274-1979 (Pilcher, 1987) and in eastern France (Lambert et al., 1989). Of particular interest for the exploitation of Baltic oak is the north Polish chronology (Wazy, 1986). It should be pointed out, however, that while there are hundreds of dated tree-ring sequences throughout the world, many are designed for post-medieval climatic and ecological studies and involve species other than oak.

With the aid of computerized chronologies and sponsorship of national organizations and universities, a dramatic increase has occurred in the number of dates obtained for ancient and medieval sites. It must be understood, however, that dendrochronology provides us with the felling date, or sometimes a felling date range for the earliest possible construction date (called the terminus post quem). This date or range of dates is not the same thing as a date for a building, and one must be cautious in accepting felling dates without understanding how to use the information. On the other hand, medievalists can be confident that in the period before 1300, timber was normally used within a year or two of felling. When the exact felling season can be established (often possible through dendrochronology) it confirms the traditional pattern of cutting in winter or early spring before the onset of the building season. Given the nature of medieval building practice, dendrochronology has become highly significant for architectural and technological history. It gives us reliable and objective (scientific) dates for a wide range of medieval artifacts and buildings against which we can compare our knowledge gained from documentary sources, stylistic change, and technological evolution from ship hulls to cathedral spires. Dendrochronology is particularly useful both in establishing phases of construction in high status, stylistically dated buildings and also for dating lower status, vernacular structures for which it may be the only tool available.

Architectural historians, historians of science, and medievalists not fully informed about this dating tool are often confused by statistical ranges for dates and ask how such a seemingly straightforward technique like counting and comparing tree rings can often produce such varied results? Perhaps when the methodology and variables involved are understood this will be less perplexing. At the outset, we must understand the fundamental difference between building a reliable reference or master chronology and the complex process of obtaining a sequence of felling dates for oak extracted from sites. Dating will also likely involve such standard research methods as stylistic, typological, structural and documentary analysis or, looking toward the future, the use of advanced techniques of botanical research such as genetic analysis for refining ring characteristics for individual tree species (See Pearson, VA, 28; Groves, VA, 31, 6).

**REFERENCE CHRONOLOGIES AND DATING PROCEDURES**

A master, or reference chronology (a reliably dated sequence) begins, in principle, with living trees of a particular species, such as oak or pine. In order to construct this critical resource for dendro dating, numerous trees are felled or bored through to obtain a core sample (Fig. 1 below). The rings inside the bark are analysed to determine the precise age of the tree. Each ring represents a year's growth. Thus, every ring width, measured in hundredths of a millimeter can be assigned to a particular calendar year. By cross matching a great number of samples from trees of various ages, the ring widths are averaged to establish a mean sequence of size and years . This long and arduous process, if successful, results in a highly reliable master chronology that covers a particular region and time span and is the foundation for dating unknown specimens. The range and usefulness of a particular chronology depends on establishing a link from living trees backward in time. For example, a chronology that has been critical for dating medieval buildings in Continental Europe is the German Master Oak Chronology, A.D. 822-1964 (Hollstein, 1965-1980). This chronology has been the cornerstone for much of the dendro dating in parts of France and Belgium and has led to the development of chronologies for the Ardennes, A.D. 1146-1991, and the Mosan (Meuse 5) chronology, A.D. 672-1991 (the region of the Meuse river between France and Germany). These sequences have, in turn, proved useful in dating buildings in Flanders and Picardy (Hoffsummer, 1995, 30-40).

**CHRONOLOGY EXTENSION AND DATING**

A master chronology is extended backwards in time by the technique of matching overlapping sequences. For example, undated specimens from the same species and region are compared ring-by-ring to a dated
sequence (Fig. 2). In some cases chronologies spanning millennia are built from chance discoveries and sub-fossil remains. This involves bridging, which occurs when a recently dated sample begins before the first ring of a master chronology, so that the cross-dated (overlapping) sequence then forms a bridge to an earlier time period.

By working gradually backwards to join undated sequences (floating chronologies) to a dated master chronology, the time span of the original sequence continually expands and thus, numerous versions of master chronologies are produced as research has progressed. Moreover, bridging opens the possibilities for the addition of new geographical regions and hence an extension of the sequences for oak and other woods. Sites once updateable by this method are now part of a global research database. Medievalists, in particular, appreciate the relatively recent addition of the Baltic States of north Eastern Europe and the extension of the Irish oak (Dublin and Belfast) chronologies. (See below)

DENDRO-DATING AND T-VALUES

Individual samples of unknown date are compared to reference chronologies by a combined process of physical (dimensional) matching and statistical analysis using computer programs such as Baillie's CROS program. The rough data of ring-width variations in a given sequence is indexed, or smoothed, by using a moving average of five adjacent widths to estimate the general trend of the raw ring measurements. The correlation between the cross-matched samples and several reference chronologies is qualitatively evaluated by the so-called Student's t value (a statistical method devised by William Sealy Gosset, 1876-1937, who used Student as a pseudonym).

A widely used adaptation of the Student's t is the Belfast CROS program designed specifically for the "high frequency" data from tree rings (Baillie, 1982, 84-85). This program is most recently discussed by Oxford dendrochronologist, Dan Miles (VA, 28, 40-41). Essentially, the calculations describe the degree of similarity or difference between pairs of ring widths (indices) at positional offsets along the sequence of data; thus, the total length of the sequence as well as the number of rings are factors in obtaining a good match (Fig. 2). When the correlation coefficient (which lies between -1 and +1) is nearer to +1, the match is closest. Taking the logarithm of this value and dividing it by N-1 (where N is the number of rings compared), the t-value is obtained.

T-values of 5.0 or better indicate good correlation, and 10 or better for English oak would tend to indicate the same parent tree (Miles, personal communication). What is important to bear in mind is that the calculations are enormously sensitive to both the number of rings averaged and the size of the rings, so that even a change of just a few hundredths of a millimeter in one ring size within a sequence can have significant consequences for t-values. According to Dan Miles, the quality of the sample is paramount. Even measuring the same sample along different or adjacent radii can produce highly variable t-values ranging from 20 to 40 and for poor samples, as low as 4 or less! Thus the dendrochronologist's dream would be oak specimens with upwards of 100 well-formed and relatively narrow rings (no doubt this is a happy tree as well). Recently, outstanding t-values of circa. 16 to 22 were obtained from imported oak from Salisbury and Peterborough Cathedrals (see below). When t-values are this high, the timber likely derives from slow growing oaks in an undisturbed site (Ireland or northeastern Europe).

HEARTWOOD AND SAPWOOD

Apart from the basic processes just described, a critical part of dendro dating concerns the heartwood-sapwood boundary (H/S) of oak (Fig. 3a). There is an easily visible physical and chemical change that distinguishes the live sapwood, or outermost growing layers where the sap flows, in contrast to the darker heartwood (dead inner wood). Sapwood is highly variable and rarely evenly distributed even in a single tree; thus, the high degree of variability of this boundary predicates that dendrochronologists have a sufficient range of samples. Moreover, the presence of sapwood within the heartwood, called included sapwood (or "moon rings"), has been estimated to occur in about 2% of European oak and is caused by hard winters and early frosts. These included rings (or, a single ring) appear as light areas like the sapwood seen in the oak slice in Fig. 3a. Historians of technology interested in structural materials involving strength of materials should note that timber with included sapwood produces regions of weakness, since this wood is less dense, less elastic, and more susceptible to decay than the surrounding heartwood. According to recent observations by Marek Krapiec, occurrences of included sapwood have been traced in England, France, the Baltic basin, and Russia extending over a considerable period of time; he suggests that these signature years of hard winters may become a useful index for recording trends both for climatology and potential dating (Krapiec, 1999).

If the bark or the last annual ring is preserved, the precise year and season in which the tree was felled can be determined; however, a dating problem often arises when the tree is converted into usable timber. To become part of a structure, the tree is felled, trimmed and cut in a particular way, termed conversion. For example, the preferred (and most expensive) conversion method for primary structural members of a medieval roof frame often involved the use of an entire tree (pre-selected for size) converted to a squared, heartwood section of oak whose bark and sapwood had been mostly removed. This is called box-heart conversion. Conversion removes a percentage of the critical dating evidence, especially in more complex carpentry whose jointing requirements would demand squared timbers, as for example, in the assembly of the arcade plate, collar beam, and hammer post in the early hammer-beam roof at Pilgrim's Hall in the Winchester Cathedral Close, recently re-dated to circa 1305 (VA, 2001). The question then arises: how can an approximate felling date be determined from partial evidence? The solution to this problem relates to
a botanical understanding of oak. Since the transition between the porous sapwood and the dense heartwood of oak is climate-related, the amount or missing number of sapwood rings can be estimated from statistics based on complete sapwood for the region where the tree was grown.

Dendrochronologists use two methods of determining the earliest plausible felling date for timber with incomplete sapwood. In England, where dendrochronology has been particularly advanced for several decades, the tendency is to use regional microclimates to determine the number of rings of sapwood normally present. For example, the chronologies for Warwickshire in the West Midlands, indicate that sapwood rings for oak vary from 15 to 40 in number and a general average of approximately 30 rings (30 years) has been used when more refined data is absent.

Elsewhere, the calculation of the amount of sapwood has been estimated by using actual measurement of ring width, as in John Fletcher’s early work, where an average of about an inch of sapwood (assuming a consistent average ring width of 1 mm) equals about twenty-five years’ growth. The sapwood-width method has been recently applied to dating oak in France, Switzerland, and Belgium. For example, for eastern Belgium, Patrick Hoffsummer calculates that the average amount of sapwood from the last hardwood ring to be 2 cm wide, which in turn averages to 16 rings, or 16 years with an uncertainty of +/- 5 years for the earliest possible felling date. While this method uses a shorter span of ring years, it makes assumptions based on averaged ring widths over a fairly wide region.

If the ring marking the boundary between heartwood and sapwood (H/S) is present, then a felling date range can be given; for example, from an H/S boundary ring dated to 1300 CE, the average range for a Warwickshire building would be 1315 to 1340. If only heartwood is present, with a last ring dated to 1300, then the earliest possible felling date would be 1315, usually printed as 1315+, but in reality the missing ring sequence with no fixed H/S boundary could extend much further, and felling could have taken place much later than 1340. In the worst case scenarios with no sapwood at all, these methods are still reliable in distinguishing building phases by generations, and as research progresses the date ranges may well become far more refined, especially in England, Belgium, and Germany.

As a caveat, historians of medieval architecture need to realize that dendrochronology at best tells us exactly when a particular tree was felled, but it does not indicate when it may have been actually used or re-used in construction. Thus, one also needs to look carefully at the integrated dendrochronology, as it only tells us exactly when a particular tree was felled. Nonetheless, in large and elite architecture constructed over a considerable period of time, an hiatus in building campaigns might easily occur after a certain amount of timber had already been felled and partially converted.

There is plenty of evidence in both ecclesiastical and domestic buildings for the re-use of timber, which remained a valuable commodity throughout the Middle Ages and was often salvaged. While in many cases, re-use is obvious from context, dendrochronology has made re-use more apparent when tell-tale signs like inappropriate joints and empty mortises are not conspicuous. In sum, if the timber in question is suitable for this dating method, dendrochronology can be extremely reliable and an invaluable aid to a variety of medieval studies and can date many objects and structures to within a generation up to about 5,000 years ago.

SUMMARY
Non-specialists need to be aware of the critical importance and complexity of the H/S boundary and t-values and especially to remember:
1. the higher the t-value, the better the match;
2. felling dates are a terminus post quem (earliest possible date for construction);
3. the replication of high t-values in several chronologies is essential for confidence in the dates obtained.

With these facts in mind, historians, archaeologists, and historians of technology can have far greater certainty in their interpretation of published felling dates and the usefulness of dendro dating in their own research.

DENDRO-PROVENANCING

While climatic variation remains the most critical factor in tree ring width and character, specific growing conditions for individual trees, whether on hills, coppiced woodlands, open meadows, or in hedges are now recognized to be of great importance. Thus, with the increased number of site and regional chronologies and new research in historic ecology, dendrochronologists now recognize that geographical proximity does not necessarily guarantee similar ring patterns.

In dating historic structures, eight to twelve core samples are normally taken to date the timber in each area of construction of a building, so that different building campaigns and resources are included in the dating process. It is also important to insure that each sample has enough rings to establish a reasonably accurate match, i.e. core samples with less than 50 rings are considered unsuitable. Taking the core samples at the correct angle and position requires skill and knowledge of the structure and construction process.

As an important by-product of dendro dating, we are beginning to learn much more about medieval woodlands, wood species exploited, and the management of these vital resources in the wider medieval economy of supply and demand. Taking a broader, interdisciplinary perspective, this information applies to material resources not just to high status buildings but for a variety of structures such as mills, manufacturing technology, fuel and transport. Also, both up and down the social scale, we can ascertain the choices carpenters and patrons made concerning the quality and quantity of timber employed in a given building (Cf. Courtenay, 1997).

In this ecological context and with the development of regional chronologies, dendrochronologists and botanists are exploring the poten-
tialities of locating timber sources, or timber provenancing. This yields a good deal of information about the types of woodlands in which trees were grown and by implication, patterns of woodland exploitation and the marketing of resources, as for example, oaks from Ireland, oak, fir, and pine from Scandinavia and woodland oaks from the eastern Baltic areas of Poland and Russia, whose trees exhibit quite different ring patterns from the traditionally coppiced oak woodlands of France, the Rhinelander, Britain, and Switzerland. Gavin Simpson (Nottingham), Ian Tyers (Sheffield), and Cathy Groves (Sheffield) have documented early importation of Baltic oak panels into England in distinction to softer woods such as Norway spruce, fir, and Scots pine also documented to the thirteenth century but rarely surviving and imported mainly in the later Middle Ages. In this area of research, one of the most important contributions to medieval studies is the development of the Danzig oak chronology.

Looking at sources in the far west of Europe, Dan Miles has recently published the results from a long-term study of the roof carpentry of Salisbury Cathedral. For example, his analysis of timber from the surviving eastern chapel roofs that remained intact after Price's reconstruction in 1736 indicates that much of the oak was imported from Ireland. Dendro dating and provenancing prove that a large proportion of the timber came from the Dublin area, and a spring felling date of 1222 with high t-values confirms documentary evidence for the construction dates for the original roofs of the eastern chapels built between 1222 and 1225 CE, the date of consecration of the chapels. It is also notable that the carpenters' marks are in Arabic rather than the traditional Roman numerals, and these are to date, the earliest known in England. (Miles, Ancient Monuments Lab Reports (AML), forthcoming; Miles and Worthington, VA 31, 2000, list 107).

Other well-known monuments also contain imported oak; for example, the backs of the choir stalls at Ely Cathedral dating to 1345 were made of Baltic oak boards of the highest (carving) quality (Groves, VA 31, 59). Most recently, Groves et al. have established from the initial phases of the examination of the roof and great painted ceiling at Peterborough Cathedral the spectacular use of Baltic oak panels. The eastern bays of the nave date to circa 1230 (with superb t-values ranging from of 9.7 to 15.2! (Groves, AML 10 and 37 (1999-2000) and VA 31, 119). This research is still in progress and will appear in subsequent issues of Vernacular Architecture. Stylistically then, this magnificent canted ceiling can be placed in the context of extant, mature Romanesque and early Gothic compositions dated to the end of the twelfth and first half of the thirteenth centuries in the tradition of the nave of St. Michael's at Hildesheim and continued later in parish churches.

Looking to the future, dendro provenancing will no doubt be of increasing interest to social and economic historians. Thusfar, the tree-ring evidence reinforces documentary references to timber imported into Britain as early as the first half of the thirteenth century. Gavin Simpson has made it clear that both oak and conifers were shipped at approximately the same time and to the same ports, mainly along the eastern coast of England, where timber resources were in decline. Knowledge of where the timber came from for medieval buildings thus widens our perspective considerably with regard to oak supplies and marketing. As in modern applications of this field, medieval trees may provide insight into the relationship between climate and population density, resource management and long-distance trade as well as unravelling the more immediate dating problems of architectural history. All this said, dendrochronology must surely now takes its place in the "toolbox" of disciplines for medievalists.

*Author's Note
I am indebted especially to Dan Miles for supplying me with information and comments, to Nat Alcock for his helpful suggestions and information, and to Gavin Simpson for his illustrations of core samples. The drawings and photographs are my own. The web sites listed are based on personal choice with a medieval focus, especially buildings. Anyone who investigates the more general sites and on-line bibliographies will discover an enormous amount of material related to earth sciences and archaeology from prehistory to the present. This listing is thus only a springboard to go in a variety of directions. I have added a short bibliography that will lead the interested reader into this fast-growing field, since what is presented here is only the tip of the iceberg.

SELECTED WEBSITES OF INTEREST:
The "Ultimate Tree Ring Site" <web.utk.edu/~grissino/references.htm> this site has nothing specifically medieval but rather demonstrates the breadth of the field & has a number of links and an enormous bibliography.

Oxford dendrochronology <www.dendrochronology.com> maintained by a leading dendro specialist, Dan Miles.

Vernacular Architecture <eds.ahds.ac.uk/catalogue> go to: Special Collections and then Dating; This is the best and most comprehensive site in the UK for access to dated buildings and artefacts; there is no comparable synthesis of dated material for Continental Europe.

Sheffield University Dendrochronology Laboratory <www.shef.ac.uk/uni/Academic/A-C/ap/dendro/dendro.html> Research currently proceeding includes the dating of vernacular medieval buildings in Devon; Windsor Castle and its woodlands; the construction of a prehistoric oak chronology for Southern Britain; the study of imported oaks and conifers.

Ancient Monuments Lab Reports (AML) <www.english.gov.uk/AMLRepSums/> This link provides useful summaries of published dendro dating projects in more detail than the Vernacular Architecture lists. Could be useful for a particular site or building in the UK.

University of East Anglia <www.cru.uea.ac.uk/> Climatic Research Unit, University of East Anglia, Norwich, UK; helpful publications list both for past and items in press.

Swiss Federal Research Institute <www.wsl.ch/land/dynamics/dendro/welcome-en.html> Research for people and the environment, Swiss Federal Research Institute WSL (Walde Schnee, und Landschaft); useful links with a section on dendro research; mostly climate and ecology.

European Dendrochronology Catalogue <www.dendro bf.uni-lj.si/sqsearch.html> Tree-ring chronologies for some European medieval buildings can be viewed on by searching period and 'medieval'. This could be a useful link to recent activity. N.B. Date ranges are very wide and reported without t-values or details of chronologies used.

Cornell University <www.arts.cornell.edu/dendro/> Relevant especially for Mediterranean studies.

Dendrochronologia <www.iiith.iitp.ac.in/dendrochronologia.htm> International Interdisciplinary Journal Published by Italian Institute of Dendrochronology, Verona, Italy.

International Council on Monuments and Sites - Wood committee <www.icomos.org/iwcc/> Focus is on preservation but there are potential links, especially to affiliated agencies that have archives.

GENERAL BIBLIOGRAPHY


Fletcher, John, ed. (1978). *Dendrochronology in Europe, Principles, Interpretations and applications to Archaeology and History*, British Archaeological Reports (BAR), International ser., 51 (Greenwich). [This is a classic discussion for Britain, but now rather dated.]


ANGEVIN ARCHITECTURE IN THE KINGDOM OF NAPLES:
A REVIEW OF RECENT STUDIES
Michael T. Davis
Mount Holyoke College


If Internationalism and a World of dissolving borders are facts of contemporary life, then the Anjou appear a precocious clan. Consider the biography of the paterfamilias, Charles I. Born in northern France to a French father and Spanish mother, this younger brother of Louis IX, came into possession of the county of Provence through his marriage to Beatrice of Provence in 1246. Answering a papal call, Charles invaded Italy, defeated the Hohenstaufen, and was crowned King of Naples and Sicily in 1266. To these titles, he added those of count of Provence, Duke of Anjou, and King of Jerusalem, and only the Sicilian Vespers thwarted plans for an expedition that aimed to make him master of Constantinople and the eastern Empire. In terms of his political identity, Charles of Anjou enjoyed an unusual range of options from which to select. And if he imagined architecture as a medium of communication of that identity, which “fundamental details” from his many “potential homes” would fashion the image for his kingdom?

Despite the strategic political importance of the Kingdom of Naples, parked at the intersection of Europe, the Mediterranean, North Africa, and Western Asia, in the late thirteenth and fourteenth century, it has been a blank on the map of architectural history—not a single building appears in the surveys of Gothic architecture written by Paul Frankl and Christopher Wilson, while Louis Grodecki covers it in two paragraphs and one illustration. However, during the past decade, Caroline Bruzelius has begun to recuperate Angevin architecture in southern Italy in a steady stream of fascinating studies. Although written as independent essays, the five articles considered here compose an interlocking suite that provides a lucid outline of building activity during the reigns of Charles I, Charles II, and Robert I the Wise approached from different perspectives: compact monographs of specific edifices, patronal case studies, and probes into the meaning of form and practice.

An informative prospect of the Angevin architectural landscape is offered by *Les villes, les fortifications et les églises dans le royaume de Sicile...*, a systematic march through royal and court projects during the century from the 1260s to the 1350s. Although pre-occupation with gaining military control of the realm and a chronically strained treasury may have limited the scope of his architectural endeavors, Charles I, nevertheless, appears as an engaged patron: documents find him impatiently bullying his master mason, threatening slow builders with imprisonment, or worrying over details of glass color. The bulk of this first wave of royal building concentrated on pragmatic defensive fortifications, but also included aristocratic residences, ecclesiastical foundations, and urban planning initiatives. Further, Charles’s grumbling that the Hohenstaufen Castel Capuana in Naples was “too German” and his command that the roof tiles of the Cistercian monastery at Realvalla be made “ad modum franciae” not only suggest his developed and discriminating sense of planning and decoration, but also hint that he wanted to produce a French architectural environment” in his official commissions.1 However, Charles’s architectural policies may have been more nuanced and more profound than the choice between “French or not French” would indicate. His edifices, judging from their surviving fragments, are not the ones we might imagine given the colonialist rhetoric, their royal pedigree, and the presence of French master masons to insure that things were “done right.” Resonant models, logically Saint-Denis, Roaumont, or the Sainte-Chapelle, were not copied nor was the optically complex linearity characteristic of contemporary elite French architecture duplicated. This disparity between expectation and fact suggests that we, as scholars, might do well to reconsider the terms in which we have defined the architectural language of the late Middle Ages and interpreted its meanings.

First, let us remember that *opus francigenum*, as Günter Binding has recently argued, was, above all a technical term that referred to systematically planned and superbly cut ashlar wall masonry whose surfaces bore toothed chisel marks. Rather than signifying a set of stylistic requirements (bar tracer, pointed arches, flying buttresses) particular visual effects (verticality, transparency), or standing for Gothic in general, *opus francigenum* was a method of production. In this light, the concern with “the French way” may have had little to do with form and everything to do with the economics of building and the organization of labor that this system, unfamiliar to the Italians, entailed. Second, the significance of what Charles built can hardly be overestimated since it shaped the kingdom’s symbolic topography and constituted a calculated performance that set his actions within a framework of legitimating precedents. The foundation in 1274 of the Cistercian monasteries of Realvalla and Vittoria, which commemorated the pivotal battles of Benevento and Tagliacozzo in the Angevin conquest of southern Italy, is surprising for by this time Capetian patronage favored the mendicant orders. Might this be a deliberate throwback to the generation of his parents, Louis VIII and Blanche of Castille, who underwrote the construction of Cistercian houses at Lys, Maubuisson, Longpont, and Royaumont? Further, attention to the urban infrastructure of Naples— including a new market, an aqueduct, and expanded city walls—recalls projects, as Bruzelius cogently notes, carried out in Paris under Philip Augustus, while the establishment of hospitals and the welcome extended to the new monastic orders, such as the Carmelites, Dominicans, and Franciscans, echoes concerns of Louis IX. With a university, vibrant commercial spaces, charitable institutions, innumerable churches, and impressive royal residences, Naples became the Angevin kingdom’s Paris, a capital city that as the communis patria embodied the entire realm and showcased the fruits good government—security, religion, justice, prosperity, education—insured by the wise monarch’s rule. Rather than
Turning at last to architectural details, if viewed from an Italian perspective, Charles I’s buildings do stand out. With structures assembled from ashlar blocks, supported by composite piers, and outfitted with crocket capitals, bar tracery, and rib vaults, they break decisively from the prevailing “historicism” approach in Italian architecture to introduce a emphatically “modern” look. To sound a variation on a theme explored by Marvin Trachtenberg, I would argue that this new vocabulary was not only—or even primarily—about being French, but instead operated on a more conceptual level to emphasize the “paradigm shift” in politics and religion effected by the Angevin conquest and the rise of the new monastic orders. The fact that the “Frenchest” of Neapolitan buildings, the choir of San Lorenzo Maggiore, was erected by the Franciscans without apparently much involvement from the throne, should be sufficient to disabuse us of the notion that these forms referred exclusively to the homeland in which they were developed (Fig. 1). This, however, is not to say that French resonance is completely absent. As Bruzelius writes, features such as the modestly ornamented portal of Sant’ Eligio al Mercato in Naples, certainly “evoked the prestige, authority, and power of French rule,” or, as I would say, “epitomized by French rule.” After all, Charles was not the king of France but master of the independent Kingdom of Naples and Sicily, and his architecture mined French forms for their thematic value rather than their nationalistic connotations. 

Under Charles II (1289-1309), the pendulum swung in a different direction. In Columnnas Marmoreas et Lapides Antiquorum Ecclesiarum and Il Gran Rifiuto, Bruzelius makes a case that the architectural policies of Charles II “can be seen as an intentional and striking contrast to the rule of his father, with a consistent attempt to position his regime as one of accommodation and adaptation to local conditions, local materials, and building traditions…” (Il Gran Rifiuto: 42). Instead of conscious modernity, projects, including the Cathedral of Naples, the Cathedral of Lucera, and the nave of San Lorenzo are notable for their liberal incorporation of antique spolia, their austere fabrics of brick and re-used masonry, their timber-roofed naves, and broad internal spaces that recall Early Christian architecture (Fig. 1). Although reflecting differences in the personal tastes and political temperament of Charles I and Charles II, the architectural shift was helped along by other factors: whatever their semiotic potential, salvaging building materials reduced costs; the failed attempt to introduce French methods of production to a local work force led to the return of traditional construction techniques; and the influence of mendicant commissions and models. Beyond practical considerations, Bruzelius sees spolia as a kind of architectural rhetoric intended to evoke the architecture of the Carolingian renovatio and thus place the Angevin Charles in a thousand-year “tradition of imperial patronage and intimate affiliation between secular ruler and the papacy” (Columnnas Marmoreas: 193).

Complementing this large-scale political agenda, spolia must be understood as site specific and, as the studies of Dale Kinney have shown, ambiguous. After all, the sixth-century nave of San Lorenzo survived more or less intact until its remodeling in the 1290s, and the Cathedral of Naples replaced two Early Christian basilicas, Santa Restituta and the Stefania. Thus, not only were ancient building materials at hand, but their re-use may have been motivated by the same impulse to link the new with the old that led Abbot Suger to seek out columns for the reconstruction of Saint-Denis. And just as one suspects that Suger’s words aimed to soothe objections to what amounted to a complete rebuilding of the abbey church by emphasizing the historicizing character of the work, the reappearance of ancient columns at the cathedral established a visible thread of continuity in a project that violently reconfigured the most venerable site in the Christian topography of Naples. Santa Restituta disappeared, most of the Stefania was demolished, and shifting the axis of the basilica 90 degrees completely altered familiar patterns of space and movement. Bruzelius is certainly right to read the use of spolia as a deliberate gesture to local history and taste, but such acts of architectural accommodation were carried out in a climate of profound change. The fate of the city of Lucera and the construction of its cathedral offers a case in point. Here, in 1300, the resident Muslim population was suppressed and replaced by Christians. Dominican, Franciscan, Augustinian, and Celestinian churches, again echoing Charles I’s foundations in Naples or Louis IX’s in Paris, were erected, along with a new cathedral, as badges of Lucera’s status as a respectable and important Christian city in the kingdom. Like its Neapolitan counterpart, the cathedral was enriched with spolia, but I would suggest that the particular context of these antique elements created a network of associations that led in a different direction. Unlike the historical connections demanded at Naples, Lucera’s cathedral, initially planned to rise over the remains of the mosque but ultimately built on a different site, sent a message of rupture. Its columnnas marmorea, while invested with the familiar values of piety and prestige, also broadcast to the population of Lucera the triumphant recovery of Christianity under the Angevin aegis and the extermination of the Hohenstaufen power that had settled the Muslims in the city. Spolia were not merely about appropriating the luster of the past; they were also the proud display of conquered booty by the victors.

Upon closer examination, the strategy of accommodation practiced by Charles II’s master masons also included “French” forms as choirs were usually vaulted, windows often included bar tracery windows, and details, such as the piscinae in the Cathedral of Naples, were executed with fashionably elegant style (Fig. 2). In the cathedral choir, the spoliated shafts of marble and granite were reset in their modern frame like antique gems or cameos in contemporary jewelry, perhaps to call attention by their luxury to the “sacrality of the space, with the most precious columns near the altar” (Columnnas Marmoreas: 193). The simpler, distinctly historicizing parti, is only fully felt in the public space of the nave. Comparable contrasts, minus spolia, inform the church projects of Giovanni Pipino of Barletta, the infamous “butcher of Lucera” and counselor to Charles II, who probably founded San Pietro a Maiella in Naples and San Bartolomeo in Lucera and played an important role in the expansion of Santa Maria Maggiore in Barletta. The Barletta choir, which rose beginning around 1290, was grafted onto an older Romanesque nave while at San Pietro, the expansive four-light east window decisively sets off the sanctuary from the nave. At the same time, it is important to recognize, as Bruzelius does, that the French references are restricted to “a series of selections, of ‘bits and pieces’” (Il Gran Rifiuto: 36). Thus, Santa Maria Maggiore in Barletta, rather than a simple-minded, provincial version of a grand northern edifice, can be better understood in the context of contacts with Naples, possibly Rome, and with mendicant

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fig. 1. Naples, San Lorenzo Maggiore, view east through nave and choir (photo: M.T. Davis)
Christian Freigang’s thoughtful and rich study joins Angevin patronage in Provence to that in the Kingdom of Naples. His goal is not to search for precise formal ties to bind the buildings into a coherent body; instead, he probes the conceptual and ideological agendas that motivated these projects. Citing the complete absence of discussion in contemporary texts, Freigang adopts a healthy skepticism about architecture’s ability to function as a subtle political instrument. Rather than a Babel of individual parts, he argues that architecture constituted a complex semantic system in which the aesthetic appearance of the whole, embodying qualities such as perfection, richness, functionality, or materiality, and animated by liturgy (and I might add imagery), made a particular “content” manifest. The fundamental question posed is how did the Anjou use their buildings as an argument for dynastic authority?

Like any self-respecting ruler, including his father, Charles II built palaces in and around his seats of power at Aix and Naples, “wondrous habitations... constructed with subtle industry, not for vainglorious display, but so that the people seeing them may be awe-struck and less inclined to rise up.” Further, his ecclesiastical commissions in Provence and Italy reveal striking parallels in purpose despite the gulf in architectural vocabularies. Take Saint-Maximin. Site of the tomb and relics, disused with the royal crown. In creating a penitential female saint as protector of their new dynasty, the Angevins borrowed a page from Frederick II’s exaltation of Saint Elizabeth in Marburg to reinforce their claims as the legitimate successors of the Hohenstaufen. Saint Januarius received a similar treatment in Naples as his burial grotto was carefully preserved in the new cathedral and a silver bust shrine was crafted for his relics.

Santa Chiara, whose construction was sponsored by Queen Sanchia, was the flagship monument of the reign of Robert the Wise. In recent publications, Bruzelius has analyzed its architecture and discussed its planning in light of the enclosure of religious women and eucharistic devotion; Freigang homes in on the church’s royal overtones. He regards the Clarissan convent as marking another change in Angevin architectural parameters, but I think it is equally plausible to regard it as the culminating example of the ascetic projects that began with Charles I’s foundations of Realvalle and Vittoria. At 46 meters, this amplitudinum opus, in Petrarca’s words, rose higher than Amiens, but what a contrast! In place of a highly articulated structure composed of a unique, even other worldly complex of shafts, moldings, and screens that emphasized visual drama, verticality and framed fields of imagery, Santa Chiara offered—what? ineffable functional purity: piers and arches grant access to lateral chapels; bare flat walls, windows, and a timber ceiling furnish shelter and admit light. Purging virtually every architectural sign of historical reference, evocative resonance, and material luxury, the insistent objectivity of this huge liturgical factory works as the embodiment of the Franciscan spiritual ideals of humility and moral reform, an answer to criticism of the pretensions of the order’s other churches, and a chaste counter-design to the decadent superfluity of elite French architecture (54).

Santa Chiara is also a thoroughly royal monument for the sole ornamental note of the interior, the huge traceried window and three openings orbiting above in the east wall, not only call attention to the altar but also accent the phalanx of tombs including those of King Robert, Charles of Calabria and Maria of Durazzo. That Santa Chiara can be read simultaneously on such disjunct levels, that its monastic integrity was fully compatible with its formal modernity and in no way compromised its aristocratic identity warn us against equating importance with optical richness or material splendor. Despite its relentless simplicity, this church is not merely about absence, the craved vision of aesthetically bankrupt puritans. True, the deliberate non-use of towers, stone-vaulting, elaborate compound piers, spolia, a transept, a triforium, figured portals, and stained glass may tell us the terms in which architectural magnificence was traditionally defined and the elements identified by the order as immoderate and shamefully superfluous. However, Santa Chiara must be viewed as the product of positive choice and a fundamental reconsideration of what a church should be by the religious avant-garde. Moving beyond historical nostalgia, visual metaphor, or narrative cyclorama to achieve a truly “aniconic” architecture, Santa Chiara shifted focus to the space of the church, the liturgy, the communal and individual acts of worship that constituted the true heart of Christian devotion.

Initially, I intended this review as a terse summary of six valuable studies of a neglected region of medieval Europe’s architectural history, and I thank those readers who are still on board for their indulgence. I lay the blame for immoderate length squarely on the authors, Caroline Bruzelius and Christian Freigang, who have provided a treasure trove of information and raised a stimulating school of issues that touches style, patronage, and architecture’s role in its artistic, political, and religious settings. Commendably, both authors, having taken Angevin architecture on its own terms, refuse to apologize for its independence from French...
norms, but neither have they reduced it to a parochial curiosity. The collective effect of these articles, in my opinion, demands that we rearticulate the terms in which we conceive and discuss what has been called “Gothic” architecture (a term that the attentive reader will note I have studiously avoided). It is time to discard the notion that late medieval architecture was a coherent “fifth order,” or, as David Gillerman has written, “a well-oiled machine with part meshing so neatly with part as to preclude adaptive reassembly,” and move beyond a canon of originality or quality based on the degree to which a structure approaches some anachronistic and fugitive notion of “correctness.” By looking at one of the architectural edges of thirteenth- and fourteenth-century Europe, Brzelius and Freigang have made it clear that nothing even remotely resembling a comprehensive system in the manner of, say, the Doric order ever existed. There may have been widely shared methods of planning, specific techniques of production, and a general agreement on the connotations of certain forms and styles, but “the Gothic,” the modern architecture of thirteenth- and fourteenth-century, was and remained an infinitely flexible kit of “bits and pieces.” Depending on the visions of patron and master mason, institutional aims, functional requirements, local traditions, materials, and economic factors, the entire deluxe set of parts could be assembled to produce the cathedrals of Amiens, Clermont, or Prague; or only a few pieces, crocket capitals, bar tracery, openwork gables, might be selected to customize a building. It was, in fact, the synthetic capacity and rhetorical potency of the catalog of modern forms, not its rationalist tyranny, that allowed builders to give physical expression to the attachments of the many homes that composed late medieval Europe.

NOTES


AVISTA SESSIONS 2003
Thirty-eighth International Medieval Conference
Western Michigan University

ILLUSTRATING MEDIEVAL MEDICINE AND THE NATURAL SCIENCES
Co-Sponsored by the History of Science Society (HSS)

These sessions seek to address a range of fundamental questions raised by the illustration of medieval medical, pharmaceutical and natural science texts in Byzantium, the Arabic world and the Latin West. How and why is imagery used to expand, clarify and replace text? To what extent do these images and other cueing systems direct the manner in which such texts are read? How do images accommodate the individual and generic features of natural objects and phenomena? Above all, to what extent do such images serve as tools for the creation of scientific knowledge?

Co-organizers: Jean A. Givens (Univ. of Connecticut); Karen M. Reeds (Princeton Research Forum/ National Coalition of Independent Scholars); Alain Touwaide (Smithsonian Institution).

I: ILLUSTRATING MEDIEVAL MEDICINE AND THE NATURAL SCIENCE
Presider: Jean A. Givens (Univ. of Connecticut)

Word and Image in Medieval Medical Texts
Peter M. Jones (Yale Univ.)

Images of Medieval Astronomy
Betsey Price (Harvard Univ./ York Univ.)

Illustrating Illnesses of the Mind in Medieval Medicine
Patricia A. Helvenston (Historical Neuropsychological Researches, Flagstaff)

II: ILLUSTRATING MEDIEVAL MEDICINE AND THE NATURAL SCIENCES
Presider: Alain Touwaide (Smithsonian Institution)

Scientific Illustrations in 15th-Century Manuscripts of Pliny the Elder’s Natural History
Sarah Blake McHatt (Rutgers Univ.)

The Tacuinum sanitatis Manuscripts from Northern Italy c. 1400 and the Creation of a New Pictorial Genre
Cathleen Hoeniger (Queen’s Univ.)

Vices and Complexions—The Representation of the System of Four Humors in the Ambit of Leonardo da Vinci
Piers Britton (Univ. of Redlands)
Word and Image in Medieval Medical Illustration
Peter Murray Jones (Yale Univ.)

The link between text and image in medieval medical illustration was often a precarious one. There are plenty of examples, especially in the early Middle Ages, of images which became detached from the text they originally accompanied, or gaps left in texts for illustrations which were never supplied. These phenomena raise questions about the hazards of the process of copying by hand, the different skills and techniques required for scribal and illuminating work, the relationship between private copying and professional workshops. This paper will address these issues, at least in passing, but the main focus will be the problematic nature of representation in medical illustration. Did artists provide pictorial equivalents to words, phrases, narratives or chapters in medical writings? Where are images to be found on the written page, and what does their placing signify? How far were representations of the human body, of natural substances, and of medical activities, governed by conventions derived from sacred or other secular genres of art? While this paper will proceed to try to answer these questions by reference to particular illustrations, it will also try to locate the answers in relation to recent theoretical concerns with representation as used in scientific disciplines.

In particular I would like to focus on the relation of word and image. Twentieth-century medical illustrators were artists and designers whose professional work of illustration was commissioned by publishers and authors to support the pedagogic role of textbooks in medical education. This tends to create assumptions about the relationship between word and image that do not help us as historians to understand this relationship in illuminated manuscripts or medieval diagrams. I shall present evidence that we can arrive at a better understanding of the production and consumption of medical images and texts in the Middle Ages by putting aside such preconceptions about their relative standing, and instead concentrate on the instabilities and changes in the relationship that actually distinguished a manuscript culture. In certain areas of medicine, particularly surgery and the domain of the practica, late medieval texts and images show a dramatic new concern with the problems of describing the appearance of illnesses, symptoms, manual operations and medicaments in ways that would persuade an audience made up of both practitioners and lay people.

Images in Medieval Astronomy
Betsey Price (Harvard Univ./York Univ.)

Drawing images has been a part of natural sciences', and specifically astronomy's, cultural production for a very long time. The role of drawing in connection with astronomy shifted somewhat after the fall of Rome, although if anything, its use may well have declined. Particularly in the Middle Ages, imagery in works whose content deals with the subjects of astronomy was the handmaiden of the text, used to expand and clarify it. By virtue of manuscript reproduction techniques alone, whereby the illuminator came after the scribe to illustrate the text, widespread works on astronomy usually saw their text as decidedly dominant over any accompanying drawings. Our understanding of the cultural-pedagogical side of illustrated astronomical texts is thus best served by appreciating that each work presents a dialogue between its text which is the antecedent and its drawings which are the follower in this context.

Despite the posteriority of their production, images in connection with astronomical subject matter were, as was virtually all medieval art, powerful enough to direct the manner in which the textual ideas were read. They might appear to be able to stand alone (and many alas today do, as a result of the selling independently of the most gorgeous pages of illuminated manuscripts). We could not, however, claim to understand adequately how an astronomical image has meaning without viewing it both inside and outside its textual context. Thus, an underlying premise of this paper is that the analysis of the social, and catalytic, uses of astronomical images should run parallel to discussions of drawing as a mode and language of representing textualised thought.

Since every aspect of the heavens was deemed in the Middle Ages to have been consciously and rigorously planned by God, astronomical drawings of all types played a significant role in reflecting that planning. They ranged from representations of theoretical constructs to working plans for the paths of planetary motions, and from sketches to beautifully executed illustrations that carefully correlate astronomy to other parts of medieval culture. Impressive illuminations were also made, perhaps for the patron of the sciences or to persuade of the importance of the study of astronomy. Scholarly drawings of celestial bodies in light of their detailed paths, for their predictable location in the heavens, and for working out special problems of astronomy were an important part of illustrating medieval astronomy. Particularly when present in manuscript autographs or apographs, medieval astronomical drawings were used to bring focus to a study and to impart clearly the author's choice between several possible concepts of the heavens' construction. As yet there was, however, no notion of using drawings to guide thinking in a way that would have enabled astronomers to remove themselves from taking a specific (philosophical) position.

Thus, unlike, perhaps, in medieval geography or cartography, there is little evidence in medieval astronomy of "fantasy" or even fantastic conceptions. Astronomical drawing played a very serious part in the philosophical-religious role the process of understanding the heavens was given, a role which led it in numerous instances to resemble contemporary religious art. The ultimate design of the cosmos was still limited by the geometric canon of Greek philosophy governed by principles of circularity and a sense of perfection, and the astronomers who studied it, by socio-religious connections in their careers. It would take a shift from Aristotelian philosophical and spatial conceptions before "speculative drawing" could become a linchpin for scientific advancement. It would also help that new forms of graphic representation would allow drawing to play a different mathematical role in the redefinition of astronomical thought. The subjective searching that medieval astronomical images represent was thus constrained, to the extent that their conception was built upon an already existing knowledge base, by previous astronomical writings, the religious convictions of the text's author, and the cultural role of the illustrator, not to mention the technological instruments at the astronomer's and illustrator's disposal. It will be argued that drawing nonetheless constituted so significant a part of the medieval astronomer's ability to communicate, that, using Albertus Magnus (c.1200-1280) as an example, a visual component was crucial to an author in self-understanding and, for us, in understanding his work.

Illustrating Illnesses of the Mind in Medieval Medicine
Patricia A. Helvenston (Historical Neuropsychological Researches)

Medieval medicine was a complex amalgam of Greco-Roman medicine, i.e., the Hippocratic Corpus as interpreted by Galen and distilled through the culture of Islam; and Patristic medicine, the elaborate healing of diseases of the soul, or as we would say the psyche, through the application of Christian principles. The Patristic traditions were developed over centuries by Fathers of the Church such as Clement of Alexandria, Origen, Tertullian, Ambrose, Jerome, and Augustine, followed by Thomas Aquinas in the high Middle Ages. To these Christian theorists sin and vice were diseases of the soul or mental illnesses and were best treated by physicians of the soul, Christ and his representatives on earth, through replacing vice with virtue, prayer, penance, and leading a life modeled upon that of Christ. The treatment of mental illnesses of sin and vice was actually a rather complex system of psychotherapy based upon a psychosocial model of the etiology of mental illness. For nearly a thou-
sand years a tradition of treating symptoms of depression and despair as described by the sins of tristitia or acedia developed alongside the treatment of melancholia, believed to be a biologically-based illness, as understood in Greco-Roman medical traditions.

Melancholia and mania in Greco-Roman medicine were believed to be caused by abnormalities of the black bile, melancholia, and the red or yellow bile, choler, as first elaborated in the humoral theory, a complex synthesis of which is included within the Hippocratic Corpus. There were standard treatment procedures which included maintaining a healthy regimen, proper attention to special diets, purging the body of noxious humours, listening to music and reading philosophy, and even psychosurgery, and we will view a number of illustrations of such treatments. In the Patristic tradition, the vice of wrath or ira was frequently paired in illustrations with tristitia or acedia, and in the later Middle Ages, illustrations of mania or madness bore a striking resemblance to earlier depictions of the sin of rage and anger. On the other hand, the symptoms and attributes of acedia were gradually subsumed within the Greco-Roman tradition of melancholia in both literary and visual arts as illustrated by Durer’s famous drawing of Melancholia.

The method of presentation will include literary and visual illustrations of the sins of acedia or tristitia and ira in the Middle Ages, along with illustrations of Christ, saints, or clerics casting out devils which, according to some medieval authorities, were believed to produce acedia, tristitia or madness such as furor, i.e., mania. Thus we will examine concepts of mental illness in the Patristic tradition, how these were illustrated, and the prescribed treatments. We will also examine illustrations of melancholia and mania in both literary and visual depictions and illustrations of treatments. Through such illustrations we will be able to appreciate how the medieval mind formulated complex syntheses between the Greco-Roman and Patristic traditions. For example, some medieval commentators believed that sin instigated by the Devil could be one cause of abnormalities of black bile and produce the biological illness of melancholia. By the late Middle Ages and early Renaissance, the symptoms and depictions of mania and melancholia had incorporated earlier symptoms of tristitia, acedia, and ira, and the illustrations of mania and melancholia bore a striking resemblance to the earlier illustrations of those Christian mental illnesses.

**Scientific Illustrations in 15th-Century Manuscripts of Pliny the Elder’s Natural History**

**Sarah Blake McHam** (Rutgers Univ.)

The *Natural History*, issued posthumously after Pliny’s asphyxiation while recording the eruption of Vesuvius in 79 AD, is an encyclopedia of thirty-seven books about science. Its scope was ambitious, even for a man who rarely slept. After providing in Book 1 a summary of its contents and sources, Pliny covered the universe (Book 2); geography (Books 3-6); man (Book 7); other animals (Books 8-11); botany (Books 12-19); botany in medicine (Books 20-27); zoology in medicine (Books 28-32); metals and stones and their use in medicine, art and architecture (Books 22-27). The *Natural History* became one of the most widely read books in the ancient, medieval, and Renaissance periods, in part because of its extensive coverage of medical remedies. Approximately two hundred manuscript copies survive today. Most are un-illustrated, or else illustrated using decorative conventions such as abstractly embellished initials or bianchi girari. Perhaps because the text had not been illustrated in the ancient world, a tradition of narrative illuminations was late to develop. Only a limited number of manuscripts of the fourteenth and fifteenth centuries are decorated with emblematic narratives related to the text, almost always in and around the initial of the beginning of each book of the *Natural History*. They illustrate a main theme of the book in an imagery that quickly became standardized. This talk will focus on one of the most lavishly embellished manuscripts of Pliny, Pico della Mirandola’s display copy dated 1481, now in the Marciana, Venice (Lat. VI, 245 (=2976). It will analyze the contents of some of the historiated initials, compare them to images in medieval herbal, bestiaries, and other medical and scientific texts, to non-manuscript sources, and to their counterparts in other manuscripts of Pliny’s *Natural History*.

**The Tacuinum Sanitatis Manuscripts from Northern Italy c. 1400 and the Creation of a New Pictorial Genre**

**Cathleen Hoeniger** (Queen’s Univ., Kingston, Canada)

The *Tacuinum Sanitatis* is the Latin version of an Arabic medical treatise written originally by ibn Butlân in eleventh-century Baghdad. Alongside many other aspects of Arabic culture, ibn Butlân’s guide to health appeared in the West during the thirteenth century and was translated into Latin at the court of Manfred of Sicily. In translation from Arabic to Latin aspects of the medical treatise were reinterpreted within the framework of the Latin West. Furthermore, I will explore in this paper how, as the treatise gained in popularity and began to be accompanied by pictures, more license was taken with the medical text.

Four luxurious editions were produced at the northern Italian courts of Pavia and Verona in the years 1380-1400. For these editions, the text was radically reduced to a recitation of a few of the properties of each medicinal substance or activity, inscribed as a caption at the bottom of each folio with a large illumination dominating above.

In the evocative illustrations a further translation and interpretation is seen. To attract their wealthy lay patrons, northern Italian court artists close to Giovannino dei Grassi created imagery that draws on chivalric pursuits and familiar religious calendar scenes, but also reflects the stimulus of the original medical source. Significantly, at times plants are rendered with some accuracy to correspond with pharmaceutical advice in the text, as in the case of "Dill" and "Fennel" in the Rome manuscript. The paintings of local people performing both leisure and harvesting activities in carefully rendered herb and vegetable gardens are largely unprecedented and appear at a time when innovations in agriculture and gardening were being introduced from the Arabic courts. Furthermore, I will point out how the earthy spirit of the Arabic text finds a response in the analogously libertine Italian paintings, which show, among other things, a couple embracing in bed ("Coitus" in the Paris ms.) Apparently, patrons and artists created a new genre of illustration to accompany the medical captions with delightful but also appropriate imagery.

**Vices and Complexions – The Representation of the System of Four Humors in the Ambit of Leonardo da Vinci**

**Piers Dominic Britton** (Univ. of Redlands)

Although artists’ growing (and not unproblematic) knowledge of the human body in fifteenth- and sixteenth-century Italy is now a platitude of art history, no one would seriously suggest that many of the figural paintings and sculptures from the period were made with the primary aim of illustrating anatomical knowledge, however much the expression of such knowledge may have been a matter of professional pride for the artist. With the theory of the four humors the situation seems to have been slightly different, because the interface between art, medical knowledge and what we might now term popular psychology was, inevitably, complex.

Humoral theory interfaced with daily life and quotidian social judgments in a way that the science of anatomy, and much other medical knowledge, did not. Unlike these other areas of knowledge, humoral theory had a "layman’s" dimension, because it provided an index of characterological and behavioral types. This particular body of medical theory was, in fact, much more pervasive in the arts and their literature than is often acknowledged. There is good reason to suppose that humoral characterizations provided a powerful visual cue for particular kinds of reflection on the part of the spectator, and moreover that the humoral system
was widely accessible to audiences.

Painters in the late fifteenth and sixteenth century demonstrably thought about their own humoral make-up and the effect their profession could have on their pathologies. Painters also consistently cast certain figures from biblical and hagiographical narrative as given humoral types. There even seems to have been a limited but still striking interest, between about 1490 and 1530, in the representation of the system of the four humors as a discrete quartet of figures (usually with a fifth, 'quintessential' figure in their midst). While this device seldom furnishes the primary meaning of an image, it always heavily inflects the content, serving as what might be termed a sub-topos. It is to the incidence of this 'sub-topos' in early Cinquecento painting that my paper will be devoted.

Leonardo may well have been the éminence grise behind all the painted images in early Cinquecento Italy which can reasonably be identified as illustrations of the humoral system. His own writings and one of his drawings reveal a deep and considered interest in the theory of the four humors, and it is striking that all extant images of the humoral types as a group are by Leonardo's known associates (or competitors). In this short paper my aim will be to sketch, with reference primarily to Bernardino Luini's so-called Christ Among the Doctors (London, National Gallery), the nature of Leonardo's engagement with humoral theory and the scope of its influence.

ART, TECHNOLOGY AND SCIENCE: INTERDISCIPLINARY STUDIES

Co-Sponsored by the History of Science Society (HSS)

The first open session sponsored by AVISTA is to encourage a variety of interdisciplinary papers that concern material culture, technology, environmental impact on resources, as well as the scientific and mechanical arts. It is hoped that younger scholars working in these areas will bring fresh research and insights to the established AVISTA tradition. Papers may present work in-progress, fieldwork, or recent methodology. The second session is designed to contain one or two more synthetic studies and is directed mainly to senior scholars/ practitioners who have published in the various areas of interest to members of AVISTA (Cf. past Kalamazoo Conferences). These papers will incorporate a panel and round-table discussion to address the state of interdisciplinary studies.

Organizer: Lynn T. Courtenay (AVISTA/Univ. of Wisconsin-Whitewater, emerita)

I: ART, TECHNOLOGY AND SCIENCE: INTERDISCIPLINARY STUDIES

Presider: Steven A. Walton (Penn State Univ.)

Lincoln Cathedral, Robert Grosseteste and the Paradox of Imperfection in the Medieval Cathedral

Nigel Hiscock (Oxford Brookes Univ.)

The Navicula Sundial: Text, Image, and Object

Catherine Eagleton (Cambridge Univ.)

The Late Medieval Consequences of the Hourglass' Apparent Atemporalty

Shana Worthen (Univ. of Toronto)

II: ART, TECHNOLOGY AND SCIENCE: INTERDISCIPLINARY STUDIES

Presider: Lynn T. Courtenay

Interdisciplinary or Not?

Christopher Currie (Institute of Historical Research, London)

Roundtable/Discussion

PAPER ABSTRACTS

Lincoln Cathedral, Robert Grosseteste and the Paradox of Imperfection in the Medieval Cathedral

Nigel Hiscock (Oxford Brookes Univ.)

The work of the late Larry Hoey and others has brought the questioning of developmental theory in the history of medieval architecture to a new level. In furtherance of a generation of individual building studies, typified by monographs on selected cathedrals, abbeys and other churches, recent investigations have drawn attention to the idiosyncrasies and anomalies to be found in their constructional design.

Some of the causes of such abnormalities include variable design, incomplete work, changes of mind and failure to resolve problems. Whilst some anomalies might be considered a conscious celebration of individuality and variety, others must undoubtedly be counted as imperfections, which in turn might appear to challenge the place of the schema in architectural design. Was this ever anything more than a notional program given by the patron to the master? How might schematic design have correlated with constructional design and the dictates of building technology? In particular for this paper, how might the presence of imperfection in the built cathedral be reconciled with the perfection of God's creation, of which the cathedral was supposed to be a model?

In an attempt to address some of these questions, the paper will take Lincoln. As a leading thinker and teacher, Grosseteste was chancellor of Oxford University and bishop of Lincoln while the cathedral was under construction. He was also author of the treatise On the Six Days of Creation, as well as various other scientific treatises. One of these, On Lines, Angles and Figures, demonstrates how an understanding of mathematical theory provides a conceptual basis for explaining natural phenomena. On the other hand, recent studies of the architecture of the cathedral, notably by Larry Hoey, have pointed to numerous idiosyncrasies in its constructional design that might appear to undermine the notion of any schema.

By taking an interdisciplinary approach that sets questions of design and building technology beside contemporary systems of thought in medieval science, philosophy and theology, this paper will draw on the writings of Grosseteste, also The Metrical Life of St Hugh, and other texts in order to examine how the bishop might have reconciled the anomalies in his cathedral with a view of it as, not only part of God's creation, but an expression of it.

The Navicula Sundial: Text, Image, and Object

Catherine Eagleton (Jesus Coll., Cambridge Univ.)

The navicula is a small portable sundial that can be used at any latitude. The extant instruments and texts date from late fourteenth- and fifteenth-century England. Surviving manuscripts, instruments and illustrations can be combined to study the uses and users of this fascinating sundial. This paper will take textual evidence from the contents and contexts of previously unstudied manuscript evidence and contemporary library records and inventories, combined with close study of the surviving material evidence and analysis of the relationships between instrument, text and illustration. First, the construction of the navicula will be discussed, drawing on evidence from the manuscript texts and diagrams, and from the surviving instruments. The manuscripts and diagrams in them can be seen to have different and overlapping purposes, and this, combined with evidence from medieval patterns and model books, and the decorative and technical features of surviving instruments, suggests that there was a standard design circulating, whether in the form of illustrations or instruments. Then, the use of the navicula will be studied and compared to contemporary practical geometry texts, to suggest that many different types of people used this instrument. I will argue that the navicula was much more common that is usually thought, and that in fifteenth-century
England interest in the instrument extended across various social groups. To conclude, I will argue that it is only by combining different sources of evidence that an instrument like the *navicula* can be studied. To look only at instruments, only at images, or only at texts risks missing the similarities and differences between them, but the combination of evidences can allow a more convincing picture of the place of the *navicula* in late medieval England to be sketched.

The Late Medieval Consequences of the Hourglasses' Apparent Atemporality
Shana Worthen (Univ. of Toronto)

In this paper, I shall argue that hourglasses were rapidly assimilated into Western scholarly culture in the fourteenth and fifteenth centuries, as demonstrated by a survey of depictions of these late medieval interval-measuring devices. They appear to have been invented around the middle of the fourteenth century; the earliest known mention of a sand clock is a ship’s account from 1345/6, and the earliest extant depiction dates from only two years later, in Ambrogio Lorenzetti’s *Allegory of Good Government*. Like so many other medieval inventions, however, there is no record of who the inventor was. The subsequent ignorance on the origins of hourglasses is likely what made them appear as a timeless technology over the course of the following century. Artists such as Antonio da Fabriano and Carpaccio, endeavoring to recreate Antiquity through their paintings, depicted the Saints Jerome and Augustine (respectively) in their studies, each with an hourglass at hand. If Polydore Vergil (*On Discovery*), who strove specifically to find the inventors of technologies, medieval and otherwise, could not find an answer to their origin, how could the well-educated artists of the fifteenth century do any better? These sources all help to demonstrate how hourglasses found a ubiquitous place in the fifteenth-century study, as well as an atemporal one in the minds of contemporary artists.

Interdisciplinary or Not? How effective and what has been the impact on historiography in the study of medieval buildings and society?
Christopher Currie (Institute of Historical Research, London)

How effective has been the interplay of documentary and architectural evidence in the investigation of smaller medieval buildings? My paper will concentrate on Britain, and on the period since World War II, and will be a very preliminary assessment, though I hope to bring in a few observations on the state of studies in Ireland and on the continent of Europe. It aims to look at the following themes:

(i) The use of documentary evidence by building investigators making architectural/archaeological analyses of individual buildings.

(ii) The extent to which building investigators, and analysts of groups of buildings, have taken account of documentary evidence bearing on the historical background to the buildings and their use (including potentially the technology and economics of construction and the sociology and mentality of use). What effect has historical study had on the theories of construction and function of buildings?

(iii) The extent to which professional historians have absorbed and taken account of the results of architectural and archaeological investigation, and its impact on medieval historiography. These themes and ideas will be used to initiate the broader roundtable discussion.

Discussants’ Comments

The Limestone Society’s Sculpture Provenance Project: excavations, materials and documentation: collaboration and interpretation across disciplines
Janet Snyder (West Virginia Univ.)

How to Define Interdisciplinarity: scholarly methodology, or as framed within the academic environment (interdisciplinary programs and their issues)?

Carol Neuman de Vegvar (Ohio Wesleyan Univ.)

Interdisciplinarity: out of the woodwork and on to the page.
Karen Reeds (Princeton Research Forum/ National Coalition of Independent Scholars)

AVISTA SESSIONS 2002

Thirty-seventh International Medieval Conference
Western Michigan University

DE RE METALLICA:
The Medieval Use of Metals
(Abstracts follow the sessions program for titles marked by an asterisk.)

I: VULCAN’S LAIR: METAL EXTRACTION AND PRODUCTION IN THE MIDDLE AGES
Organizer-Steven A. Walton (Pennsylvania State Univ.)

Presider-Paul Gans, New York University

SMELT: Large-Scale Iron Production in the Past*
Carl Blair (PI Univ.)

Ore, Fire, Hammer, Sickle: Iron Production in Viking Age and Early Medieval Iceland*
Kevin Smith (Buffalo Museum of Science)

Breaking the Mould: A re-evaluation of Viking-age mould-making techniques for oval brooches applied to an Icelandic Setting*
Michèle Hayeux-Smith (Univ. of Glasgow)

Ulrich Rülein von Kalbe’s ‘Bergbüchlein’ in the Context of 16th-century Mining/Metallurgical Literature (withdrawn)*
David E. Connolly (Ohio State Univ.)

II: METALS FOR MARS: MILITARY USES OF METAL
Organizer and Presider: Steven A. Walton (Pennsylvania State Univ.)

A Replica of the Sutton Hoo Sword*
Scott Lankton (ABANA Artist-Blacksmith's Association)

The Glancing Surface and its Effect on 14th century Armour (withdrawn)*
Douglas Strong (Principal, Glenbrook High School)

What’s the point? A Metallurgical Insight into Medieval Arrows*
David Starley (Royal Armouries Museum, Leeds, Conservation Dept.)

III: ALL THAT GLITTERS: CRAFT AND DISPLAY IN MEDIEVAL SECULAR METALWORK
Organizer and Presider: Carol Neuman de Vegvar (Ohio Wesleyan Univ.)

A Viking-age brooch fragment from recent excavations at Temple Bar, Dublin*
Niamh Whitfield (Morley Coll./Birkbeck Coll., Univ. of London)

The Savernake Horn: an ophion adorned with metal*
John Cherry (The British Museum, London)

The iconological functions of gold in the Dunstable Swan Brooch (withdrawn)*
Richard Schneider (York Univ.)

The Loving Cup—the Ceremony and its Derivation*
Julian Lea-Jones (Bristol Historical Research)

IV: ARCHITECTURAL USE OF METAL IN THE MIDDLE AGES

The Loving Cup—the Ceremony and its Derivation*
Julian Lea-Jones (Bristol Historical Research)
V: METAL RELIQUIARIES AND LITURGICAL OBJECTS
Organizer and Presider: Scott B. Montgomery (Univ. of North Texas)

All that Glitters is not Gold: Materials and Value in Medieval Reliquaries
Cynthia Hahn (Florida State Univ.)

Christ Human and Divine: The Chalice of Abbot Suger
Geneva Kornbluth (Univ. of Maryland)

Liturgical Objects and Liturgical Space: a view from Early Medieval Ireland*
Michael Ryan (Chester Beatty Library, Dublin)

DE RE METALLICA—PAPER ABSTRACTS
SMELT: Large-Scale Iron production in the Past
Carl E. Blair (Michigan Technological Univ.)

Medieval metal workings are generally associated with small scale craft activities, however such small scale activities were not always the rule. The evidence from the Smelt experiments and the Smelt/Low Birker field work in Cumbria, England, show that large-scale sustained iron workings were possible. The sustained, ca. 100 year duration of the workings at Low Birker in the Esk Valley of Cumbria also argues for carefully planned support and resource acquisition strategies for the iron workings that allowed the Norse/British populations of the area to sustain their activities for multiple generations.

ORE, FIRE, HAMMER, SICKLE: Iron Production in Viking Age and Early Medieval Iceland
Kevin Smith (Buffalo Museum of Science)

Iron was produced in Iceland from the ninth century, when the island was settled by Norse colonists, until the sixteenth century. As a fundamental industry for this medieval Scandinavian outpost, iron production offers unique insights into the changing organization of the society and its economy. Starting with archaeological data gained from recent excavations at a ninth-tenth century smelting site in Western Iceland, this paper will employ geological, archaeological, and historical sources to shed light on the integration of iron production (quarrying, smelting, manufacture, distribution, and repair of tools) into the changing economic structure of Viking Age (875-1000 CE) and Early Medieval (1000-1264 CE) Iceland.

BREAKING THE MOULD: A re-evaluation of Viking-Age mould-making techniques for oval brooches applied to an Icelandic setting
Michele Hayeur-Smith (Univ. of Glasgow)

In light of recent experimental trials conducted at the Department of Archaeology of the University of Glasgow and the Department of Silversmiting of the Glasgow School of Art, it was revealed that the technological processes involved in Viking-age mould-making, as stipulated and described by modern scholarship, were lacking in practical knowledge of metalworking, and the social concerns of Norse craftsmen ignored. In this paper, these techniques and issues will be addressed. Furthermore, this research was undertaken with the Icelandic context in mind in order to verify to what extent jewelry was locally produced in this new colony, and to what extent local Icelandic conditions of the Viking period were suitable for mould-making, casting and jeweler production in general.

ULTRIC RÜLEIN VON KALBE's BERGBÜCHLEIN in the Context of 16th-century Mining/Metallurgical Literature
David E. Connolly (Ohio State Univ.)

Georg Agricola and his De re metallica (1556) are justifiably accorded a seminal position in the history of mining/metallurgy and of early modern science writing generally. (Indeed, the AVISTA sessions for 2002 are organized around Agricola's title!) The earliest printed book on mining, however, is Ulrich Rülein von Kalbe's Bergbüchlein and pre-dates De re metallica by around half a century. Rülein's "booklet" and a number of other pre-Agricola German texts (e.g., on mining law, assaying, etc.) witness to a substantive process of Verschriftlichung of the important technical arts associated with metals in the first half of the sixteenth century, culminating in Agricola's famed masterpiece. Relatively little scholarship has been devoted to the earliest printed texts on metals and mining during the last half-century (cf. Sisco and Smith, 1949; Mendels [diss.], 1953; Pieper, 1955; Koch, 1963). In this paper, I shall present a survey of the publications of Rülein and the other early sixteenth century texts and of the scholarship on them, and offer a new appreciation of the significance of Rülein's Bergbüchlein in the development of Early New High German Fachliteratur.

A Replica of the Sutton Hoo Sword
Scott Lankton (ABANA: Artist—Blacksmith's Association)

In 1990, I was asked to replicate, as precisely as possible, the magnificent sword found in the Anglo-Saxon ship burial at Sutton Hoo in England. This paper will cover a small amount of background on the sword and its environs, but will primarily be a technical explanation of how a pattern-welded sword of similar design can be made, illustrated with slides as examples of pattern-welding.

THE GLANCING SURFACE AND ITS EFFECT ON 14TH-CENTURY ARMOUR
Douglas Strong (Principal, Glenbrook, High School, Glenview/Northbrook, IL)

It has long been known that the discovery/popularization of the glancing surface revolutionized the world of armour. By making armour so that weapons such as lance points and sword blades skid harmlessly off the plate, armourers could create pieces that were lighter, more streamlined and all together safer. However, the popularization of the glancing surface resulted in many other defenses that certainly were the product of some painful encounters. It must have been discovered soon after the glancing surface came into vogue that a skidding weapon was not always harmless. No doubt these weapons slid into openings in the armour and thus into unguarded parts of the wearer's body. This is evident by the wide variety of turned edges, stop ribs and liserie d'arrets designed to help the weapon to deflect elsewhere where it would not injure the wearer of the armour.

If we examine armour of the fourteenth century, when the glancing surface was relatively new, we can see many inventions that serve to turn skidding weapons from vulnerable regions of the body. These are affixed to nearly every part of a suit of armour. We can see them on great helms, bascinet visors, breastplates, arm harnesses, and leg harnesses, essentially every piece of armour that employed the glancing surface.

WHAT'S THE POINT? A METALLURGICAL INSIGHT INTO MEDIEVAL ARROWS
David Starley (Royal Armouries Museum, Leeds, Conservation Dept.)

As mass-produced artifacts of the medieval period, arrowheads survive in large quantities in the archaeological record. Historic textual references and illustrations have proved to be of relatively limited value in explaining the context, development and specific functions of the wide range of "types" of arrowheads. This paper uses a study carried out at the Royal Armouries Leeds, to show the possible contribution which metal-
lurgical examination can make in looking at both the manufacturing and heat treatment history of individual artifacts and, in the longer term, the introduction and decline of specialist types. It is suggested that "high tech" compact broadhead warheads, containing heat-treated steel, were part of ongoing technological competition, to maintain the effectiveness of the military archer, against increasingly effective plate armour on the battlefield.

A Viking-age brooch fragment from recent excavations at Temple Bar, Dublin
Niamh Whitfield (Morley Coll./Birkbeck Coll., Univ. of London)
Recent excavations at Temple Bar West, Dublin, have revealed for the first time traces of habitation which go back to the ninth century, when Dublin was first founded by the Vikings. The gold filigree panel which forms the subject of this presentation comes from a level at the site dated to ca. 940-50. It formed part of a kite-brooch, a type of dress-fas	
tener which was in fashion in Ireland (and nowhere else) from the late ninth/early tenth to twelfth centuries, and is the earliest securely dated example of the type. As it comes from a Viking town, it might be thought that its design and manufacture would reflect Scandinavian influence, but this is not the case. On the contrary, the style of animal pattern it displays and the filigree techniques used to create this pattern are very much in the native Irish tradition. This is consistent with the character of other tenth-century finds from the site and supports the view that the Dublin Vikings were quick to integrate with the native Irish, a conclusion supported by recent historical studies. The best parallels for the piece also come from a Hiberno-Viking context and date from the mid-ninth to the mid-tenth centuries. As few pieces of Irish animal ornament can be securely dated to the tenth century, this piece is a significant addition to the corpus.

The Savernake Horn: an oliphant adorned with metal
John Cherry (British Museum)
Elephant ivory horns, oliphant, were objects of great importance in the tenth-twelfth centuries. Producing an astonishing sound, they will forever be associated with Roland and his death. The elaborate decoration of such horns will be compared with walrus ivory horns of the twelfth and thirteenth centuries. On the Savernake horn, the elephant ivory is enhanced by the use of silver and enamel to display authority, function and status. Translucent enamel gives the horn an opportunity to glitter in the sunlight. The horn therefore represents a transitional moment between the older ivory tradition and the newer use of metal that was to become more widespread in the later Middle Ages.

The Iconological Functions of Gold in the Dunstable Swan Brooch
Richard Schneider (York Univ.)
As the most precious of metals, gold is an obvious medium for the creation of expensive jewelry. But the iconological significance which gold contributes to a figurative display piece reaches far beyond the market value of the bullion. This paper argues that, at least in the case of one famous object, the goldsmith called on all the intrinsic, extrinsic, and symbolic properties of gold as "precious" metal — understood phenomenologically by a high medieval mentality — to create the meaning of his object. The Dunstable Swan Jewel (Age of Chivalry # 659) in the British Museum is an object of exquisite beauty, and is clearly an expensive display piece. But the iconography of this brooch gives it particular interest beyond these common properties of all fine jewelry; the swan motif connects it in a special heraldic way to the Bohun heritage, and through that connection to Henry IV, the first Lancastrian king of England (whose wife was the heiress Mary Bohun). As such, it offers an interesting case of the way intrinsic properties of gold contribute to a figurative display piece far beyond the mere visible properties of gold itself, all of which blends together into the rich significance of the Dunstable Jewel for its purchaser and its wearer. Thus, the functionalism of the Dunstable Swan as a heraldic object stems from a much deeper well of meaning than the mere explicit fact of its subject matter. Included in its meaning is a multi-layered range of significances derived from the gold metal which provides its material base; indeed, the gold is an absolutely necessary aspect of the Swan as a heraldic jewel.

The Loving Cup - The Ceremony and its Derivation
Julian Lea-Jones (Bristol Historical Research)
Those attending functions where they are invited to partake of the "Loving Cup," whether by this, or any of its other names, may not realize they are participating in a ritual, that goes back to medieval times and beyond. In some instances the vessel that the celebrants will be drinking from will be a large double-handed elaborately decorated silver-gilt cup, many centuries old. Although drinking ceremonies have been noted throughout recorded history, those found and noted within the context of this research date from 450 CE and are from within the bounds currently defined as the United Kingdom. The alternative names referred to include: The Grace Cup, Poculum Charitalis, The Pledge Cup, The Mermaid Cup, and the The Byrde Cup. Research into the background of one such Loving Cup ceremony, which regularly takes place today in Bristol, England and dates from the 1500s led to the discovery of parallels with other similar drinking rituals. The particular drinking ceremonies described have continued in an unbroken succession from the days of the medieval craft guilds and baronial halls right through to today's university colleges, London livery companies, masonic lodges and civic ceremonies. The research covers the evolution of the ceremony, together with the reasons for and examples of the ritual wording with an explanation of how the cups themselves have evolved from classically simple but important wooden objects to often elaborate and prestigious objects in their own right. In the Middle Ages, drinking vessels were often of horn or maple, when the British name for maple "Marsam" evolved into the more familiar term "Mazer". The use of metal, whether
La pierre armée dans l'architecture rayonnante française
Alain Erlande-Brandenburg (Musée national de la Renaissance)
L'architecture rayonnante se définit avant tout par la réduction de la maçonnerie pour agrandir les baies, ainsi 618 m² de baies à la Sainte-Chapelle. Pour aboutir à ce résultat, les architectes ont mis au point des techniques nouvelles de construction, au cours du XIIe siècle.
La première, appelée par Viollet-le-Duc, la «fenêtre-châssis» a permis de rendre la baie indépendante de la maçonnerie. Elle pouvait être ainsi considérablement élargie.
La deuxième a été l'utilisation du fer destiné à renforcer la maçonnerie de pierre. Dans la baie ou le triforium, les barres de métal horizontales reliaient les meneaux, taillés en délit, à la maçonnerie pour assurer la cohésion et éviter l'éclatement sous la pression du vent. L'emploi du métal a été étendu aux roses pour obtenir des diamètres de 20m et bientôt à l'ensemble de la maçonnerie pour mieux résister aux poids, aux tensions.
C'est ainsi qu'à la Sainte-Chapelle, l'utilisation du métal s'est étendue à l'ensemble de l'édifice.
Cette technique a été rendu possible grâce à la fusion du métal en bas-foursneau qui le rendait inoxydable et lui donnait un coefficient de déflation réduit. L'apparition des hauts-foursneaux imposa un renouvellement complet par abandon du métal, la stéréotomie permit grâce à une taille sophistiquée de la pierre de répondre aux exigences du maître d'ouvrage.

Liturgical Objects and Liturgical Space: a view from Early Medieval Ireland
Michael Ryan (Chester Beatty Library)
Le paper examines the range of remarkable liturgical vessels (especially those from the Ardagh and Derrynaflan Hoards) preserved from early medieval Ireland and establishes a context for them in art historical and archaeological terms. Their liturgical use is examined and the issue of liturgical space is briefly considered. Comparanda in the Merovingian and Carolingian worlds are examined and technical aspects of construction, as they relate to liturgical function, are considered. In particular the questions of the manufacture of sumptuous vessels for purely votive purposes and the role of patrons are raised. The techniques of manufacture are situated in their local technological context and issues of availability of raw materials and approaches to design and construction are examined. In particular it is noted how the ambitions of designers posed problems which were difficult to solve with local technologies. These were then stretched in novel ways to meet the demands of patrons.

The Use of Iron in Medieval Timber Structures
Nat Alcock (Univ. of Warwick)
The medieval use of iron has attracted most attention as a decorative medium, in grillwork, door and chest fittings, and as structural strengthening for stonework. Its use as an adjunct to timber construction has been much less studied, although such applications are frequently encountered both in standing structures and in documents. The present paper will examine the use of such items as nails, iron braces, straps, and ties, and identify where medieval carpenters felt the need for such aids. As well as the obvious applications of nails for the fastening of laths and other minor structural elements for which nails were essential, iron was used surprisingly frequently; the most intriguing cases are probably examples of major timbers that underwent structural failure during construction due to warping or the exposure of weaknesses while joints were being cut. These timbers would then need to be strapped in place. The mundane use of ironwork in hinges, bolts, and similar fittings will also be considered, contrasted to its decorative applications. Documentary evidence for the crafting of these items, the craftsmen, and the supply of materials will also be discussed.

Les roses des XIIe et XIIIe siècles : une recherche d'équilibre
Chantal Hardy (Univ. de Montréal)
Certains historiens d'art considèrent que c'est en tant qu'image architecturale, souvent accompagnée au XIIe siècle d'un décor sculpté enrichissant les façades, que fut créée et diffusée la fenêtre circulaire. Pour les historiens du vitrail il va de soi que ces fenêtres circulaires servirent essentiellement a supporter les verrières exposant de grands cycles théophaniques ou des compositions organisées à la manière de rotae des manuscrits.
Nous examinerons ici les liens qui existent entre armature de métal et remplissage de pierre dans l'élaboration des roses des XIIe et XIIIe siècles en France. De l'origine ancienne de ce type de fenêtre à la création des grandes roses du début du XIIIe siècle, deux types de construction ont été utilisés en parallèle. D'une part on élaborera à partir des traditions de l'oculus polychrome une formule qui aboutira aux grandes roses style plate tracery. D'autre part, c'est à partir de la fenêtre-roue qu'on mit au point une autre formule de construction qui permettra d'exécuter les très grandes roses du début du XIIe siècle et celles de style rayonnant.
L'examen des rapports techniques entre ces deux matériaux dans le développement des roses révèle une dynamique importante, elle-même soumise au dictat architectural qui exigera un accroissement phénoménal du diamètre de ces roses.

AVISTA SESSIONS
at the Leeds Medieval Conference
8-11 July 2002

DE RE METALLICA:
The Medieval Use of Metals

I: ALL THAT GLITTERS: CRAFT AND DISPLAY IN MEDIEVAL SECULAR METALWORK
Organizer and Presider: Carol Neumann de Vegvar (Ohio Wesleyan Univ.)
Gold in the ground or just rust in the dust: measuring wealth by metalwork in Anglo-Saxon graves
Gale Owen-Crocker (Univ. of Manchester)
Display of Scandinavian Migration Period Bracteates and Other Pendant Jewelry as a Reflection of Prestige and Identity*
Nancy L. Wicker (Minnesota State Univ., Mankato)
The role and status of goldsmiths in Anglo-Saxon England
Elizabeth Coatsworth (Manchester Metropolitan Univ.)
Une bague du XIIe siècle et ses inscriptions: entre identité et pouvoir, magie et prophylaxie
Elisabeth Antoine (Musée National du Moyen Âge, Cluny)

II: ALL THAT MIGHT NOT GLEET: METALS FOR WORLDLY GOODS
Organizer and Presider: Steven A. Walton (Pennsylvania State Univ.)
'Brightness in a time of Dark': The production of secular metalwork in 9th-century Northumbria*
Gabor Thomas (Sussex Archaeological Society)
III: METAL RELICARIES AND LITURGICAL OBJECTS
Organizer and Presider: Scott B. Montgomery (Univ. of North Texas)

Mathilde’s Cross and Theophano’s Reliquary: Liturgical Metalwork from
Ottoman Essen
Karen Loaiza (Pittsburgh State Univ.)

Romanesque Portrait Relicaries and the Imprinted Likeness
Thomas E. A. Dale (Univ. of Wisconsin - Madison)

Art Imitates Architecture: A Relic of St. Philip and Its Reliquary in
Quattrocento Florence
Sally J. Cornelison (Virginia Tech. Univ.)

IV: USES OF METAL IN MEDIEVAL ARCHITECTURE
Organizer: Ellen M. Shortell (Massachusetts College of Art)
Presider: Robert Bork (Univ. of Iowa)

Metal Use at the Cistercian Church of Altenberg
Sabine Lepsky and Norbert Nussbaum (Universität Köln)

Solid as a Rock: poured lead joints in medieval masonry
Jennifer Alexander (Univ. of Nottingham)

Squelette de Pierre ou squelette de Fer? Fourniture et utilisation du métal
dans la construction du Palais des Papes d’Avignon au XIVe siècle
Philippe Bernardi and Philippe Dillman (CNRS)

V: MORE USES OF METAL IN MEDIEVAL ARCHITECTURE
Organizer: Ellen M. Shortell (Massachusetts College of Art)
Presider: Robert Bork (Univ. of Iowa)

Pitt Ferro che Marmo: Iron and Lead in the Construction of Milan
Cathedral
Charles Morschew (Drexel Univ.)

Adam Kraft’s Sacrament House in St. Lorenz Church Nuremberg: Metal
Construction in Support of Design (withdrawn)
Beata Hertlein (Büro für Bauforshung und Kunstgeschichte, Bamberg)

Ironwork at the Top: A Medieval Jigsaw Puzzle in Salisbury Cathedral’s
Spire
A. Richard Jones (Independent Scholar, Los Altos, California)

Technology Transfer in Medieval Architecture
Steven Walton (Pennsylvania State Univ.)

DE RE METALLICA—PAPER ABSTRACTS

Display of Scandinavian Migration Period Bracteates and Other Pendant
Jewelry as a Reflection of Prestige and Identity
Nancy L. Wicker (Minnesota State Univ., Mankato)

Scandinavian gold jewelry called bracteates must have been among
the most visually impressive indicators of status during the Migration
Period. These objects were equipped with loops so that they could be
suspended as ostentatiously displayed pendants. Wear on the loops
demonstrates that they were used extensively in life, and burial evidence reveals
that they were worn by women. Bracteates contributed to a rich costume
ensemble whether worn singly or as part of a necklace with additional
bracteates, other gold pendants, gold "spacer" beads, and glass and amber
beads. The prestige conveyed by bracteates was enhanced by the multi-
plied effect of combination with other objects, but bracteates carried an
explicit Nordic iconographic message in their animal-style ornamentation.
When worn by elite Scandinavian women married off to foreign chieftains
in Anglo-Saxon England and Lombardic Hungary, bracteates also
connoted Scandinavian identity as well as secular prestige. In this paper,
combinations of objects found with bracteates will be examined to
determine their contribution to the overall effect of bracteate necklaces.

‘Brightness in a time of Dark’: The Production of secular metalwork in
9th-century Northumbria
Gabor Thomas (Sussex Archaeological Society)

Perhaps with the exception of sculpture, when one speaks of an
Anglo-Saxon Northumbrian cultural tradition an implicit connection is
usually made with artistic media produced during the eighth century
when the kingdom had reached its political and cultural apogee.
Examples abound with which to highlight the strength, vitality and
distinctiveness of the kingdom’s cultural output during that century, the most
familiar and celebrated being the products of her monastic scriptoria and
workshops which form the basis of our recognition of an Insular monastic
artistic tradition.

What I would like to demonstrate in my paper is that the following
century a period of Northumbria’s history usually approached from the
perspective of troubled political events rather than her cultural achieve-
ments, witnessed the continued expression of a lively cultural tradition,
even if the creative energy behind such activity may have shifted away
from its earlier, predominantly religious, roots. Using an important new
hoard of ninth-century ornamental metalwork recently discovered outside
York as a focus, I will examine the principal stylistic characteristics of
this tradition and the basis for its recognition among a range of contem-
porary personal ornaments and weaponry decorated in the ninth-century
Tewhiddle style. By also drawing upon excavated manufacturing evi-
dence, I will argue that the stylistic interrelationships highlighted amongst
this metalwork are a vivid reflection of a local Northumbrian cultural
identity which continued to find an outlet for expression well into the
nineteenth and even twentieth centuries. Furthermore, I will suggest that despite
the economic disruption caused by a worsening domestic political climate
and the Viking incursions, the quantity, and in some cases, outstanding
quality, of this metalwork is an indication that the Northumbrian kingdom
continued to sustain the very highest levels of secular patronage.

The making and maintaining of a 13th-century lead water conduit -The
Carmelite’s Friary Pipe, Bristol England
Julian Lea-Jones (Bristol Historical Research)

Bristol, today home to half a million people and a major contributor
to the European aerospace industry, grew from a key medieval town and
staple port. Yet today, in AD 2001, it still has a number of surviving
examples of medieval leaden water conduits. Bristol, situated on the bor-
der between the ancient Kingdoms of Wessex and Mercia, because of its
role as a staple port, became the second most important town in medieval
England.

Bristol’s importance led to four monastic orders and other religious
houses establishing themselves in or around the medieval town. This
paper focuses on the engineering achievements of one such order, that of
the Carmelites, or White Friars, although other ancient monastic water
supply systems in Bristol and elsewhere, are referred to for comparison.
The Carmelites’ system of pipes and tunnels dating from 1267 was built
to carry and safeguard the water from their springs on the upper slopes of
the surrounding hills, down to their friary a third of a mile away - the
singularities of the route necessitating a sealed pipe for part of the route. In
1376 they extended their system to provide water for their neighbouring
parishioners. After the confiscation of their possessions on 30 July 1538
by the King (The Reformation), their water supply and pipe, although continuing as a supply for the parishioners, was also put to a number of secular uses.

My group's research started in 1986 with a field survey to develop a topographical overview of the system and to gain an understanding of the problems facing the monastic engineers. The findings of this initial survey enabled a framework to be established for the main research and to place the results into the historical context of life in Bristol in the Middle Ages. Subsequent analysis and comparative research with other systems enabled the identification of the manufacturing methods used for the pipe construction, together with the engineering reasoning and methodology, as well as the maintenance and financial background.

The civic authorities responsible for the maintenance of the system today in 2001, seven hundred and thirty four years after its construction, use the information arising from this research. Historians are also given an insight into an often-overlooked aspect of life in a medieval English town.

A Fourteenth-Century Spanish Manuscript on Silver Coin Alloying and Assaying
Ricardo Córdoba de la Llave (Univ. de Córdoba, Spain)

This paper studies part of manuscript number 46 in the Colegiata de San Isidoro (León), the first late medieval technical text that has been found in Spain. It is divided into two different works both dated to the fourteenth century. The most important chapter in the manuscript is a handbook of commercial arithmetic entitled Book of the Alguarism, a compilation of mathematics questions similar to the so-called liber abaci of late medieval Italy that includes a number of problems related to silver alloying. But in the middle of this mathematical text there is a small handbook devoted to teaching the methods of making silver assays entitled "Book that teaches the assaying of every coin." The text of assaying, inserted between a section of problems about the alloying of silver coin, is very similar to the other European handbooks related to this topic and dated between the twelfth and sixteenth centuries (such as those of Pegolotti, Probierbiichlein, Juan de Ricardo Cbrdoba de la Llave (Univ. de Spain)).

The regulations specify the duties and responsibilities of the mining officials and workers including the Bergmeister of the district (who is appointed by the King), the mine judge, jurymen, mine, mill, and smelter managers, reservoir superintendent, surveyor, shift bosses, contract miners, blacksmiths, laborers in mines, mills, and smelters, drovers, woodmen, women and maidens washing the tinstone, and the young boys sorting the ore from waste. The wages of the day workers are stipulated. Leasing of mines to adventurers is controlled by the Bergmeister. Leases may be lost if mines are not worked within three days. Mine leases can be hereditary but will pass to the Crown's freehold if not worked within six weeks. The Bergmeister's office and individual mines must keep accurate account books under pain of severe punishment. Pay days are every Saturday and days of valuation of tin production are quarterly. Tin trading is free and the responsibility of the miners. Mine regulations include aspects of the worker's safety and health. Medical expenses due to injuries whilst working are the responsibility of the mines. Lost wages are insured by deductions from weekly wages. Trespassing by anyone on the mines and mills is an offense.

Some regulations deal with life in the mining towns. The Burgermeister and Town Council resolve civil disputes and civil criminal cases. The jurisdictions of the Burgermeister and Town Council are separate from those of the Bergmeister but the latter presides over legal appeals. Market days are regulated so they do not affect work on the mines. A schoolhouse and school master are to be provided. Town butchers must reserve their suet for the mines that require the suet to make candles.

The regulations close with the oaths, which the mining officials have to swear to on taking their positions. The oaths declare that the officials will ensure that the mineworks will come to no harm, and that they will endeavor to increase mine profits and the Crown's Tenth.

The regulations affected both the working and family lives of the miners. The effects were both good and bad for the miners. Working conditions were improved and their families benefited by more law and order in the towns and by the mandated provision of schools. However, controls in the mines and towns by the Crown and officials became stricter. The miners had been mostly independent in prior centuries, but the 1548 regulations made them wage earners working in part for the benefit of the Crown.

Squelette de Pierre ou squelette de Fer? Fourniture et utilisation du métal dans la construction du Palais des Papes d'Avignon au XIVe siècle
Philippe Bernardi and Philippe Dillman (CNRS)

Nous sommes en train de travailler sur l'utilisation du métal dans un grand chantier gothique, celui du Palais des Papes d'Avignon. Cette enquête repose sur une approche conjointe des comptes conservés et d'une analyse de laboratoire des éléments prélèvés sur place (titans, éléments agrafes...). Elle a pour premier objet de mettre l'accent sur l'importance du recours au métal dans la conception même de cet édifice. Au-delà, notre propos est de nous intéresser à la fourniture même de ce matériel (origine, mode(s) commercialisation, nature des produits vendus, applications, qualités...). L'enquête engagée a, jusqu'à présent, porté sur le pontificat de Clément VI (1342-1352) et la construction du Palais Neuf. Le dépouillement des comptes nous a permis de mettre en évidence la livraison de milliers de "barres" de métal dont la fourniture peut être mise en relation directe avec certains travaux. Il nous a également permis de déterminer le coût et le poids d'une grande partie des éléments fournis, et de mieux cerner leur marché. Nous avons, parallèlement, repéré, et prélève, une quinzaine d'échantillons dont l'analyse à permis de préciser le mode de façonnage et de déterminer l'existence de plusieurs origines.

Pitt Ferro che Marmo: Iron and Lead in the Construction of Milan Cathedral
Charles Morscheck (Drexel Univ.)

The Fabbrica of the Duomo was, before the rebuilding of St. Peter's, the largest, best organized and best documented church-construction project in Europe. Many account books in its archive record in minute detail all sorts of expenditures and receipts, from the beginnings of construction about 1387 to the present. This paper examines two types of account books: Dati et Recepti which are records of expenses and receipts, and Libri Munitionum, which are records of distributions of materials to the workers. Both types of book give copious information about the uses of
metals in the structure of the cathedral, and particularly about three types of iron element: tie-rods, clamps and pins, all fused into the marble structure with lead.

The interior columns are tied together with iron tie-rods inserted above their capitals, so that the arches bearing upon them do not require buttresses. This vaulting technology is based upon the tensile strength of iron rather than the mass and non-compressibility of stone buttresses. The cathedral is built of brick with an interior and exterior veneer of marble. The blocks of marble are tied together laterally by iron clamps which are like large iron staples inserted at the tops of two adjacent blocks, spanning the seam between them. The columns consist of a core of rubble and mortar surrounded by marble blocks. The blocks are linked to their lateral neighbors with clamps, so they cannot shift in relation to each other, nor can they be forced outward by the pressure of the settling core. Iron pins help join adjacent marble segments (botazoli) of vaulting ribs. They are inserted in holes bored into the adjoining faces of the botazoli, and they prevent the segments of the rib from slipping out of line. This technology differs from that of the Gothic cathedrals of the North. This kind of documentation can be used to produce an accurate chronology of the construction.

Adam Kraft’s Sacrament House in St. Lorenz Church Nuremberg: Metal Construction in Support of Design
Beata Hertlein (Büro für Bauforschung und Kunstgeschichte, Bamberg)

From 1994 to 1998, I conducted an architectural study on the design and construction of Kraft’s sacrament-house. The results are documented in numerous plans, photographs etc. Scholars sometimes write that Kraft was able to build the sacramento-house without any structural and static obligations at all. But this simply cannot be true if you take into account that the delicate structure was erected up to a height of c. 20 meters using several tons of sandstone, mortar, iron and lead. On the contrary, precise examination shows that Adam Kraft developed a construction and static design explicitly using wire and iron support. Above the Crucifixion group, the downward forces are diverted vertically as well as via iron to the ambulatory pillar. This way of deflecting the weight of every single story is the starting point to create the very delicate structure of the sacrament-house with its light and freely developing impression. Below the Crucifixion a very complex static system is concealed within a shaft constructed of several lightweight single elements between corner posts connected with several iron elements. The diversion of forces into the ambulatory pillar and the connection of the several workpieces are the result of combined iron levers and protruding iron constructions. Most important is the ingenious fitting of protruding baldachin elements to the pillar combining the balance of forces with levers and forked iron girders. The additive way used by Kraft in erecting the sacrament-house essentially relies on the connection of single elements with iron wallplugs as well as stringing on wire. His sacrament-house therefore may well be seen as a highlight of late medieval engineering with its impressive use of diversion of forces and shift of weight as well as with its employment of levers, clamps, wallplugs and armature.

Ironwork at the Top: A Medieval Jigsaw Puzzle in Salisbury Cathedral’s Spire
A. Richard Jones (Independent scholar, Los Altos, California)

An ingenuity of ironwork links the walls, capstone, and interior timber at the top of Salisbury Cathedral’s spire, some 400 feet above the ground. Two articulations of this ironwork are examined in detail to propose a sequence for the ironwork’s installation as the spire was being constructed. The form of the ironwork is shown to imply that the timber structure within the spire was part of the original construction.

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<WWW.Papers INVITED.com> was conceived and developed to assist those numerous scientists, professors and student researchers who have had a difficult time in tracking the Calls for Papers from various universities and professional bodies.

Conferences devoted to Medieval Art and Architecture:
The Conference site is at: <http://www.efn.org/~acd/medfest.html>
The Medieval Page <http://www.efn.org/~acd/medievalpage.html>
Resources in Art History for Graduate Students
<http://www.efn.org/~acd/resources.html>
Remember also the ICMA website:
<http://www.medievalart.org/html/conferences.html>

The BSI database is an iconographic index of baptismal fonts from the early Christian period to the 17th century from over 30 countries...we currently have over 6,500 font records and over 5,000 digitized images. The best way of getting a quick overview of the project is to visit the web site: <http://www.library.utoronto.ca/basi/>

Danish medieval wall paintings: information on the present day conservation techniques of the 600 village churches in Denmark now known to have wall paintings dated 1100-1600 can be found at: <http://www.natmus.dk/cons/walls/chrhpnt.htm>

Visit Bede’s World, the recreation of a Northumbrian village, made with the tools and materials available in the eighth century and including plants and animals. For news and events, see the web site:
<http://www.bedesworld.co.uk>

Medieval Illuminated Manuscripts from the National Library of the Netherlands (Koninklijke Bibliotheek) contains thousands of high quality images browsable by subject (ICONCLASS) or searchable through a database. Find the site at <http://www.kb.nl/kb/manuscripts/>

Architecture religieuse, a site devoted to Christian religious architecture, includes such premier French Gothic monuments as the cathedrals of Le Mans, Meaux, Metz, and Rouen. See the site at <http://architecture.relig.free.fr/>

Bourges Cathedral has a website: <http://www.diocese-bourges.org/cathedrale>
For other monuments in the diocese, including abbeys in the departments of Cher (Noirlac, Plainpied, Saint-Satur) and Indre (Méobeq, Deols, and Fontgombault), see <http://catholique-bourges.cef.fr/monuments/index.htm>

NEWS
Announcing Volume 1 of Medieval Forum, an electronic journal for the promotion of scholarship in Medieval English Literature. We hope the articles will spark a scholarly dialog between authors, readers and editors. Please visit our website at <http://www.sfsu.edu/~medieval/>. MF is dedicated to providing a venue for the free exchange of ideas in a collegial, public forum environment. Critical essays on works from any genre or period of the medieval corpus are invited, and a humanistic orientation is encouraged. Although the focus of MF is on literature, articles from other disciplines, particularly cultural and historical, that will contribute to the study of literature are welcome. Submissions are invited for Volume 2, anticipated in March 2003 with a 15 January deadline. Visit our website for guidelines.

Fire destroys Sweden’s most important medieval church
As reported in The Art Newspaper, Sweden has lost one of its most precious works of art to fire. The medieval church of Södra Råda near Kristinehamn in the Varmland burnt down in October 2001. Built of wood dated to 1310 and painted the traditional blood red, it was decorated all over its plank surfaces with medieval wall paintings. The first date from 1323. The nave was later painted with biblical scenes by one Amund, who signed and dated his work 1494. He and his workshop decorated at least a dozen churches in central Sweden and it appears from his style that he had access to French Gothic illuminated manuscripts. <http://www.allemanni.com/TAN/index.asp>
BUSINESS MEETING OF AVISTA

held at the Thirty-seventh International Congress on Medieval Studies.
3 May 2002, Western Michigan University, Kalamazoo Michigan

12:02 p.m. Meeting called to order by Lynn Courtenay, President.
Welcome. Big goals from last year have been met. The first volume of the Ashgate series is coming out. (John Smedley: in the Fall). For Leeds we will have advertising. We have an issue of the Forum, and Michael's assurance that he has the next Forum almost complete, the material in hand.

**Elections Committee:** Paul Gans
Election of Board members:
- Nominating committee: Kathryn Talarico and Paul Gans.
- Slate of seven nominated candidates:
  - Richard Sundt, Nigel Hiscock, Harry Titus, Carol Neuman de Vegvar, Janice Mann, Jean Givens, Abby McGehee.
Call for nominations from the floor? None.
Janet Snyder volunteers to count ballots.
Results: New board members are: Richard Sundt, Harry Titus, Carol Neuman de Vegvar, Janice Mann, Jean Givens.

**Election of Officers:** (by Board members)
Candidates:
- President - Lynn Courtenay;
- Vice-president - Kathryn Talarico; Secretary - Barbara Bowers;
- Treasurer - Evelyn Lane.
Call for nominations from the floor? None.
Results: Officers as proposed are elected.

**Secretary's Report:** Barbara Bowers
Call: For amendments and corrections of last year's minutes (previously distributed). None.
Call: For ratification of last year's minutes (Lynn Courtenay).
Carl Barnes moves the minutes be ratified.
Janet Snyder seconds.
No corrections. Minutes from 2001 are accepted.

**Treasurer's Report:** Harry Titus
Issue: The need is to have a smooth transition of the treasurer's office to Evelyn Lane, who is unable to attend due to the death of her father. She will take over in August.

**Issue:** The problem is supporting publication costs. We are at a break-even point now, where without outside funding, implementing new programs and supporting new initiatives is not possible. We will be losing Wake Forest's help with expenses (mailing, supplies).

**Issue:** (Concerning AVISTA Forum) we are in trouble with our institutional members. There have been many complaints, either to have the journal or refund the money. We should have the journal out now. We are not facing the problem. The treasurer needs to know when the journal will be out!

**Issue:** That the Ashgate series is tying up our most active people.

**Discussion of the Treasurer's report:**
Lynn Courtenay: We do need to take note that we have had a short income year and we are going to have a lot of expenditures.
Richard Sundt: We would be in a lot worse shape without the anonymous $5,000.00 grant. We are not really self sufficient. That money is gone now.
Carl Barnes: Question to Harry Titus: How many members are there?
Clarification of report, income from members reflects only new members. Dues were suspended because the journal did not go out last year.

**Executive Committee Business:**
Lynn Courtenay: Motion that Marie-Thérèse Zenner be formally approved as Annual Program Director, and member of the executive committee.
Second: Barbara Bowers.

Lynn Courtenay: Motion that Ellen Shortell be formally approved as Publications Chair, and member of the executive committee, to replace Nancy Wu who is retiring.
Lynn Courtenay: The executive committee (wifars) is: the president, Kathy Talarico, Barbara Bowers, Evie Lane, Marie-Thérèse Zenner, Ellen Shortell.
Call for nominations for two members from the board to serve on the executive committee.
Nominations: Jean Givens and Steve Walton.
Motion: for Steve Walton to continue as Web site manager.
Election by show of hands. Unanimous. Applause.

**PUBLICATION COMMITTEE BUSINESS:**
**AVISTA FORUM JOURNAL**
Lynn Courtenay: Commenting: The problem with the Forum has not gone away. We need to push ahead and resolve this problem. The publications committee will have to take on the problem of budgeting for the Forum.
Harry Titus: Motion: That we ask the publications committee to begin looking for a new Editor.
Second: Barbara Bowers.
Third: Paul Gans.
Lynn Courtenay: Call a vote: To delegate the Publications Committee to look for a new Forum Editor.
Vote by show of hands. The motion is not carried unanimously, but passed by a majority.
Lynn Courtenay: Commenting: "There is a good deal of sympathy for Michael as Forum editor, who over the years has carried tremendous loads, who really made the Forum the successful publication that it was earlier. We should not forget that Michael has said that he would like to continue on being active with the Forum in some capacity. Let it be noted that this is a transitional phase we are going through and that Michael needs more help".
Barbara Bowers: Need to clarify from the minutes of last year's meeting. Michael had agreed to continue as Arts and Architecture Editor. There were also a number of people who had volunteered to be Assistant Editors. We are already sitting on a revised editorial staff for the AFJ. Michael is already free of the responsibilities of being Editor, while still remaining very active.
Lynn Courtenay: Issue: That speakers from the sessions with papers of "in process" or "less formal" content be encouraged to submit to AFJ.
Issue of quality control. That the AFJ be faster and less formal. To be up front with speakers. Address the lack of materials problem.
Carol Neuman de Vegvar: Commenting: Heretofore, people publishing the AFJ were largely members. Need to invite outsiders. Need to be timely. Get new writers.
Paul Gans: Adding: It is an urgent need!
Lynn Courtenay: Call: For volunteers for the Publications Committee as extra help.
Carol Neuman de Vegvar: Noting: The gravity of the situation. Need to carefully select the next Editor.
Lynn Courtenay: Suggesting: A young scholars section in the AFJ, and to allocate funds for an editorial assistant.
Rob Bork: Question: What does AFJ cost?
Harry Titus: $1,600 to $1,800 per year. Expect $1,600 to go out for next issue, same size, at Copy-Cat.
Richard Sundt: Issue: Mailing costs. What will Bucknell's involvement be?
Harry Titus: None. "They are entering willingly and cautiously".

**Concerning Ashgate**
Lynn Courtenay: Issue: A request by Marie-Thérèse Zenner to shift funds from Erlande-Brandenburg (original allocated travel budget) to the Gimpel volume. 500 pounds sterling is needed for art paper. As a show piece and as an important volume for our organization.
Dick Jones: Motion: To use 500 pounds sterling from the general fund to
upgrade the paper for the Gimpel volume.

Second: Rob Bork.

Vote by show of hands. Unanimous.

**Issue: Allocating funds: The Kress money to go to the series, rather than an individual volume?**

Carol Neuman de Vegvar: It is unknown what may be needed for the Metallica volume. We should send in a request to Kress to use funds.

Barbara Bowers: We formally requested Kress to use the extra money from the hospital sessions for publications. Funds left over are committed to the hospital volume. Working under the assumption that the extra money ($530) to go for illustrations not covered in the contract. A wait-and-see situation.

Rob Bork: Kress grant to metal sessions: $10,000 total, $7,500 for speakers, $2,500 for publication. There is $80 surplus from monies allocated to speakers. It will be complicated. Don’t know where it is going. It is a huge project.

Harry Titus: Call: To define needs as close as possible for the volume.

Lynn Courtenay: To officially thank Harry for years of service and WFU, upgrade the paper for the Gimpel volume.

Applause.

Lynn Courtenay: To officially thank Harry for years of service and WFU, retiring as publications chair and for the success of **AD QUADRATUM**. Applause. Lynn Courtenay, to write to WFU and the Cloisters.

Meeting declared adjourned ca. 1:10 p.m. by Lynn Courtenay

Submitted by Barbara S. Bowers, AVISTA Secretary

**NOTES FOR CONTRIBUTORS**

To facilitate preparation of the AVISTA Forum Journal, the editor requests contributors to follow the guidelines listed below.

**Form**

1. Manuscripts must be clearly printed on a letter-quality printer on start size paper. Please use ten or twelve point type.

2. If possible, send the disk of your manuscript prepared on Microsoft Word for Macintosh. Include a hard-copy print-out with your disk.

3. Notes must be supplied at the end of the manuscript on separate pages. Please do not embed them in the text.

**Notes**


2. Abbreviate title of this journal as *API*. Other periodicals should be spelled out in first mention.

**Illustrations**

1. Illustrations are the responsibility of authors. You may send legible photocopies of visual material for the initial submission of your manuscript. For publication, high-quality, glossy black-and-white prints are essential. They should be no smaller than 5 by 7 inches. Images may be submitted electronically in a high quality jpg or tiff format.

2. Original drawings should be submitted whenever possible, although high-quality photocopies of line drawings are acceptable. The editor will not redraw faint copies or attempt to interpret ambiguous sketches.

3. Authors are responsible for obtaining permission to reproduce illustrations when necessary and for any fees associated with their publication.

4. Authors should provide illustration captions printed on separate pages at the end of the manuscript. Information should include the name of the building or object, location, date, specific description of image, source: e.g. Saint-Urbain, Troyes, begun ca. 1263, interior, choir (photo: M. Davis).

**Miscellany**

1. Dates: use figures and numbers as 10 June 1194. Form the plural decade without the apostrophe: 1130s. For bracket dates write each year in full: 1220-1269, not 1220-69.
AVISTA FORUM JOURNAL NEEDS YOU!!

AVISTA Forum Journal depends for its survival on the submissions it receives. For the next issue in 2003 and those that will follow, I invite all readers, members and non-members alike, to contribute original articles, reviews of scholarly publications, conferences, or museum exhibitions relating to the history of art, architecture, construction, science, or technology. These pages are dedicated to the promotion of positive and stimulating interchange, and reports on work-in-progress and studies by younger scholars are especially welcome. Your ideas are our strength!

Contributions on any aspect of medieval science, technology, or art in Europe or Asia or their impact on and afterlife in the modern world are invited. Analytical and critical reviews of recent publications (articles, books, electronic) are invited.

Please send articles or reviews to:

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