PUBLICATION OF THE TEXAS FOUNDATION

FOR ARCHAEOLOGICAL AND HISTORICAL RESEARCH

SUMMARY OF THE 1998 EXPEDITION

TO

THE ABBEY OF VALMAGNE

HOUSTON, TEXAS

APRIL 1999

THE 1998 TFAHR EXPEDITION TO THE TEXAS A&M PROJECT AT VALMAGNE AND THIS PUBLICATION WERE MADE POSSIBLE BY FINANCIAL ASSISTANCE FROM THE FOLLOWING:

THE TEACHER SPONSORSHIP PROGRAM:

A program established in 1996 to underwrite the full costs of one teacher per expedition season:

Eulah Matthews
Richard & Kathy Moiel
Terrence & Mary Murphree
William Neidinger
Aline Waszkowski
Cairns Family Trust

DONATIONS FROM:

Bert & Nancy Corkill
Jack & Jean McCaine
Virginia Flatow
James & Ruth Harrison
Dixie & Marja Smith

And

CONTRIBUTIONS FROM:

Ira & Brenda Allen
Ford & Hazel Bankston
Ronald & Susan Bankston
Morris & Renate Berk
Robert & Lucy Blome
Jeanne Brandis
Bernadette Child
Fred & Marcia Christian
James & Bea Coatsworth
Allen & Lucille Cummings
Mrs. Sidney Faust
Kathleen Gammill
Jack & Linda Greenwade
Roberta Howell
Sam & Susan Kamas
Olive King
David & May Litowsky
Lou Medley
Mary Olsen
Steve & Carolyn Pali
Allen & Sue Reagan
Julian & Margaret Reeves
Joseph & Lynne Saporito
Walter Schroeder
Jean Schulman
Edward & Ethel Shannon
Jean Sides
Mrs. David Tandy
Katheryn Taylor
Isabel Turner
Clinton & Carolyn Wong
Elizabeth Wood
Keith & Claudia Zacharias
Harold & Dorothy Zeiler
Jacqueline Zilker
Harry & Erla Zuber

and Six Anonymous Donors

For more information, contact:
Dr. William J. Neidinger
TFAHR
5478 FM 2673, Suite #143
Canyon Lake, TX 78133

INTRODUCTION

In the early 1970s Vivian Paul, while travelling through southern France collecting material for her dissertation, visited the Abbey of Valmagne. She was asked to write an article on the abbey by the editor of *Mélange à la Mémoire du Père Anselme Dimier*; that article appeared in 1982. From 1984-1992 Vivian Paul, teaching at Texas A&M University, was doing survey work in the region of Narbonne; she was joined in a project surveying the cathedral of Narbonne by Robert and Eva Warden, Lonnie Champagne, and a number of students from Texas A&M University. In 1989 Vivian Paul delivered a lecture in Narbonne on French Cistercian architecture; attending that lecture was Madame d'Allaines, the current owner of the Abbey of Valmagne. Subsequent visits to Valmagne by Paul, the Wardens, and Champagne developed into an agreement with Madame d'Allaines for a three-year project to survey the abbey's church and cloister. Work began in 1996. In 1997 Vivian Paul and Robert Warden extended an invitation to Eulah Matthews and William Neidinger of the Texas Foundation For Archaeological & Historical Research to join them in their final year of work on the Valmagne project. A contingent of teachers associated with TFAHR was assembled and joined the Texas A&M team for the month of June 1998. This publication is a summary of the work done by the teachers and students of Texas A&M and TFAHR.

Figure 1. France

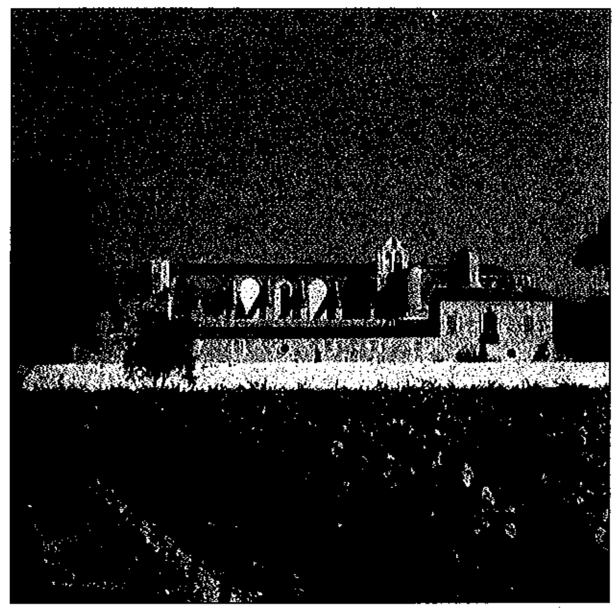
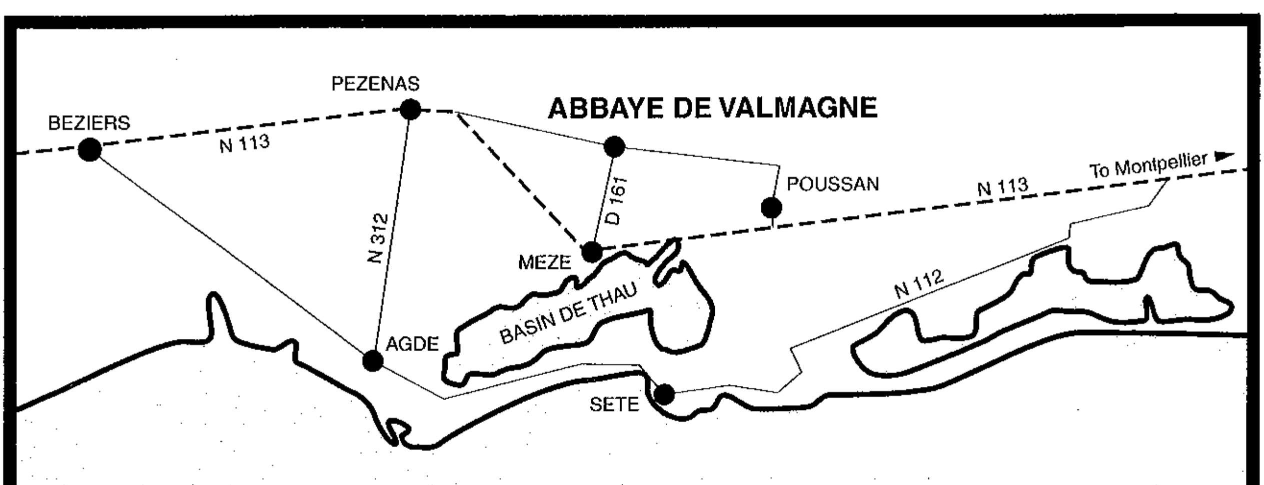


Figure 2. Valmagne.



Detailed Map.

A Brief History and Short Description of the Cistercian Abbey of Ste. Marie de Valmagne
By Eulah Matthews and William Neidinger

In the eleventh century there was established in the diocese of Albi the Benedictine Abbey of Adorel. With the passage of time conditions at Adorel became quite crowded prompting Abbot Foulques to leave the monastery in the spring of 1138. With a sizable following of monks he crossed the Lacaune and Espinouse Mountains to the shores of the Mediterranean, stopping not far from the Thau Lagoon in the region of Tortoriera, an arid scrub land inhabited by wild animals. Here they carved out a small piece of the wilderness, called over the ages either *Vallis Magna* (The Big Valley) or *Villa Magna* (The Big Mansion), which would eventually be Francified into "Valmagne" (See Figure 2). It was located near an abundant, perennial water source and was protected from the north winds by a sheer wall of limestone jutting out from the earth. It also happened to be near the Via Domitia, the ancient Roman road linking the province of Gallia Narbonnensis with Italy.

Raymond Trencavel, Vicomte of Beziers, granted an endowment to the new monastery, possibly that same year, and in 1139 Bishop Raymond of Agde blessed its foundation. Valmagne was placed under the authority of the Monastery of Cadouin in Perigord and dedicated itself to following the Rule of St. Benedict. But the second abbot of Valmagne, Abbot Pierre, had designs to transfer the monastery to the authority of Citeaux in 1144 or 1145.

Citeaux, the home of the Cistercian Order founded by Robert of Molesme in 1098, espoused a form of the Benedictine Rule, stricter and more austere than was commonly practiced. It claimed to hearken back to the original intentions of St. Benedict himself, who, in the sixth century, imposed upon his monks a regime of poverty, penance, solitude, and prayer. The Cistercian reform of the Benedictine Order spread rapidly throughout Europe, eventually founding more than seven hundred monasteries.

The placement of Valmagne under the authority of Citeaux was accomplished not without a certain amount of difficulty. Abbot Pierre, armed with the written consent of his monks, wrote to Pope Eugenius III to obtain dispensation from obedience to the monasteries of Ardorel and Cadouin. This was agreed to, in principle, in 1145 by a Papal decree, releasing Valmagne from the authority of the said monasteries. Valmagne was finally and definitively attached to the Cistercian Order by a decree of Pope Hadrian IV in 1159.

Cistercian monks were sent to instill in the brothers of Valmagne the customs of the Order, to verify their charter, and to determine whether the site met all the necessary conditions: absolute solitude, a reliable water source, and sufficient lands to support the monastery. The self-sufficiency of each monastic enterprise was an integral part of the Rule of the Cistercians; all abbeys had to be provided with a water source, a mill for grinding flour, a vegetable garden, and workshops for the various trades so as to render it unnecessary for the monks to leave the abbey grounds.

The first abbey church was, according to tradition, built on the highest point of the site by eighty monks in the latter part of the twelfth century. If the monastery followed the typical Cistercian layout, the plan would have taken roughly the following design: the church would have been in the form of a simple Latin cross and adjacent to it, the cloister. A square or rectangular cloister enclosed a fountain (if possible) and into its four wings would have been built the usual library, sacristy, chapter room, auditorium, infirmary and scriptorium. A dormitory for the monks usually occupied the upper story of the east wing of such a complex and on the south wing were the kitchen and the refectory. The west wing of the complex provided lodging for the lay brothers attached to the monastery. (It was the lay

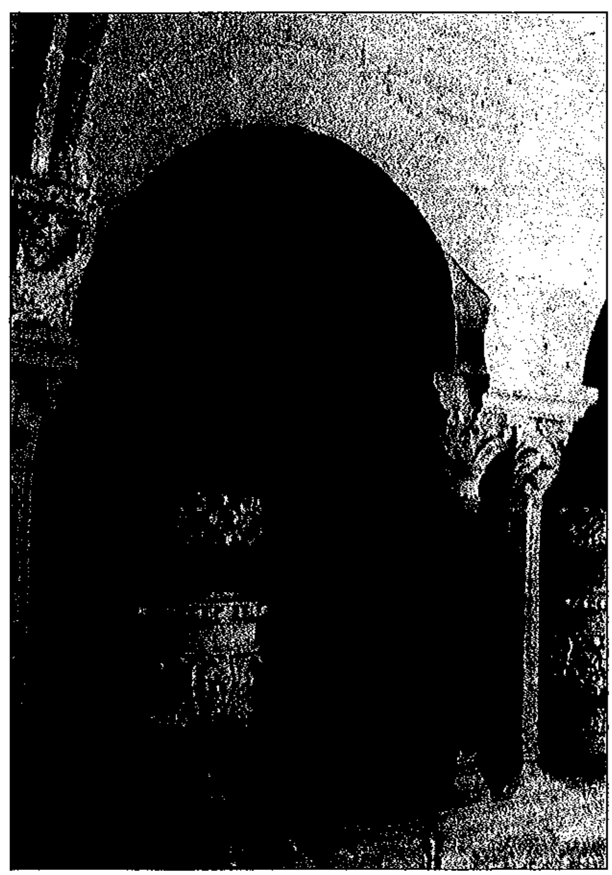


Figure 3. East wing of the cloister, entrance into the chapter room. Note rounded arches.

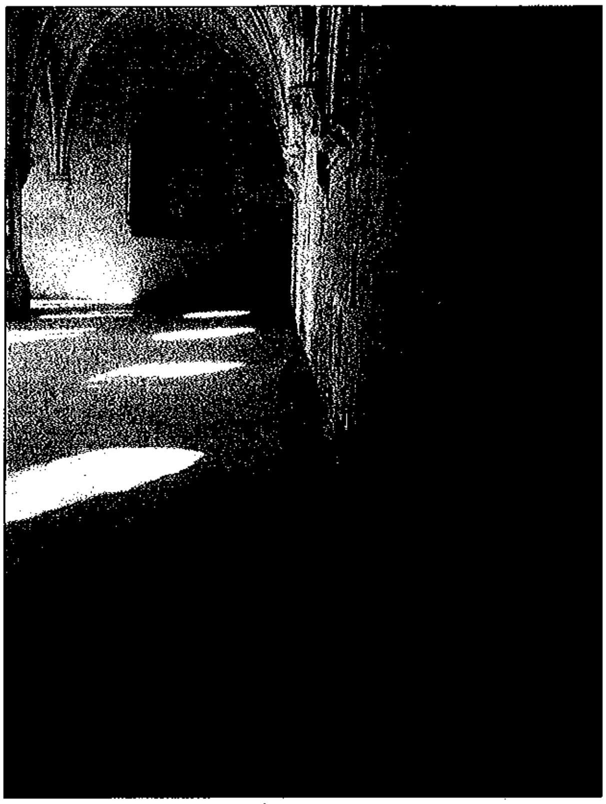


Figure 4. North wing of cloister. Note stones from earlier structure protruding through modern floor.

Figure 5. South transept wall. Note round arch and window of the twelfth century imbedded in the later wall.

brothers, recruits from among the local peasantry, who maintained the agricultural estates associated with the abbey. They cleared the land and sowed and harvested the crops. And the lay brothers who worked the distant estates of the monastery would leave the abbey in the spring to do the sowing, stay gone until the harvest was in, and then return to the abbey for the winter.) The north wing was usually just a covered ambulatory abutting the church's outer wall.

Some remnants of this twelfth-century structure are still visible in the extant buildings of the monastery. The basic structure of the sacristy, chapter room (where meetings of the monks were held), auditorium and most of the west wing, with their low rounded arches (See Figure 3), seem to place them in the context of the first building phase of the monastery. In addition, what appears to be the lower course of an earlier wall still protrudes through the modern pavement of the cloister in the north wing (See Figure 4). Another telling remnant of the first structure can be discerned in the stonework of the south transept wall. Here, imbedded in the later thirteenth-century wall, can still be clearly seen the traces of a circular "rose window" surmounted by a round arch that would have been the top course of the twelfth-century wall (See Figure 5). The window was filled in in the thirteenth century and the earlier wall incorporated into the later wall. Such a re-use of the earlier structure is also visible outside the apse

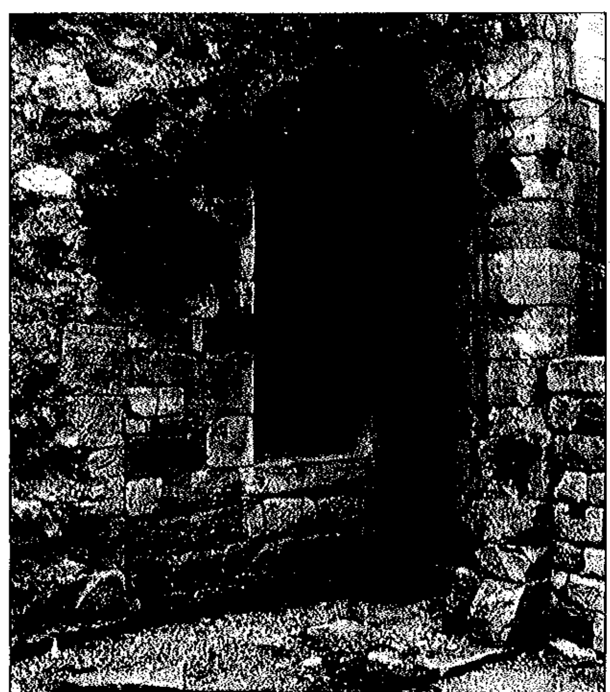


Figure 6. Intersection of apse wall and sacristy; note remains of earlier wall in foreground.

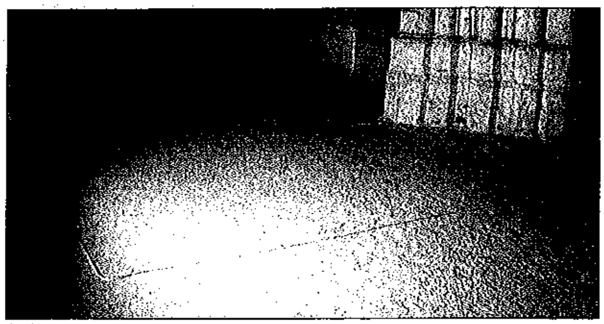


Figure 7. Laying out the excavation trench between the piers.

Figure 8. Beginning excavation.

Figure 9. (A) Thirteenth century floor. (B) Foundation of thirteenth century piers.

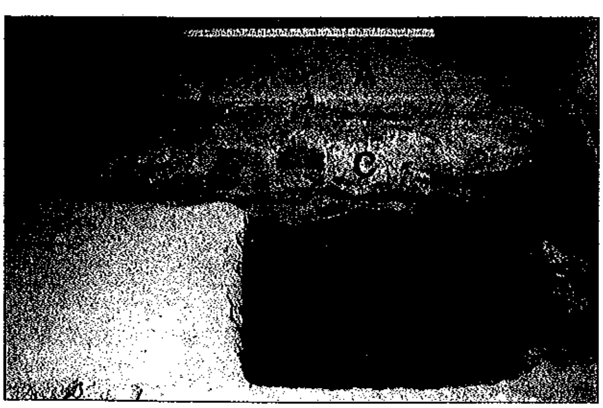


Figure 10. (A) Thirteenth century floor. (B) Foundation of thirteenth century piers. (C) Stone and mortar floor foundation. (D) Remnant of twelfth century structure.

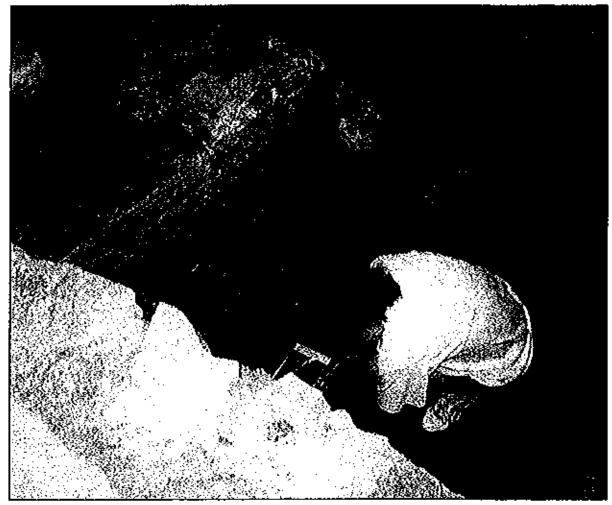


Figure 11. Digging along the side of the earlier structure.

of the church where the apse intersects the south transept wall and the sacristy (See Figure 6).

Another portion of the earlier church was uncovered during the 1998 season when permission was granted to open a small exploratory trench within the church itself, between the two piers between the southern choir bay and apse chapel (See Figures 7-11). At a depth of less than five centimeters beneath the extant packed dirt floor of the church the stone paving of the thirteenth-century church was uncovered. Wishing to avoid damage to the paving stones, excavation continued only in that part of the trench where the paving stones were missing. It was discovered that the southern pier partially rests upon a remnant of the earlier church. What exactly that architectural remnant may be remains uncertain, the narrowness of the trench and the shortage of time (the last day of the season) precludes any definitive conclusion. The earlier remnant consists of three courses of well cut ashlars cemented together. These three courses rest upon a lower course which protrudes slightly from the line of the upper three courses; it is not known whether there are any more lower courses.

The early days of the Abbey of Valmagne constituted a period of great prestige, growing wealth, and expansion. Over nine hundred charters mentioning donations of lands, privileges and exemptions were recorded in the cartulary of Valmagne, begun around 1185. Some of Valmagne's early abbots, at this time elected by the monks themselves, are recorded as participating in the Cathar or Albigensian Crusade (1209-1249). Among these was Abbot Bertrand of Auriac who, in 1247, assisted in the surrender of the last of the rebellious Trencavel counts to King Louis IX, which effectively ended the crusade against the Cathars.

In 1257 that same Abbot Bertrand, undoubtedly

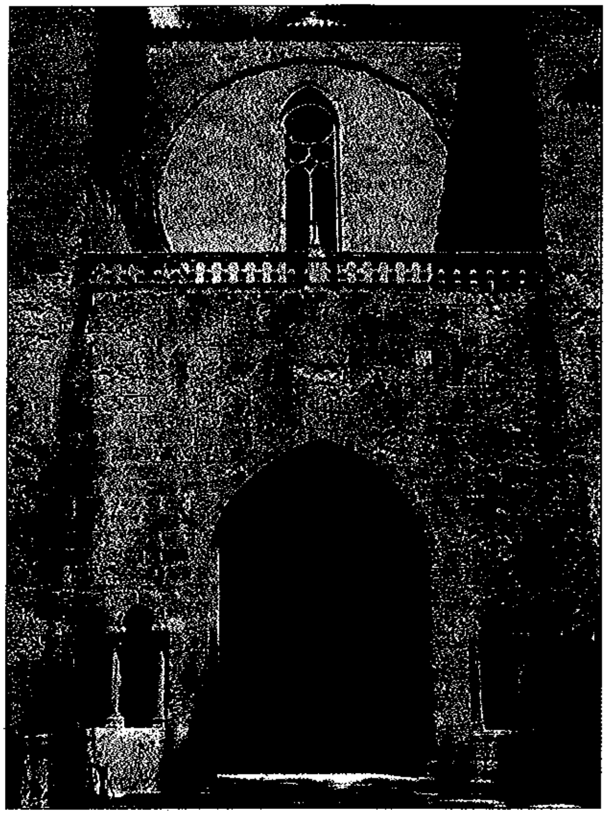


Figure 12. Filled in rose window of entrance to the church.

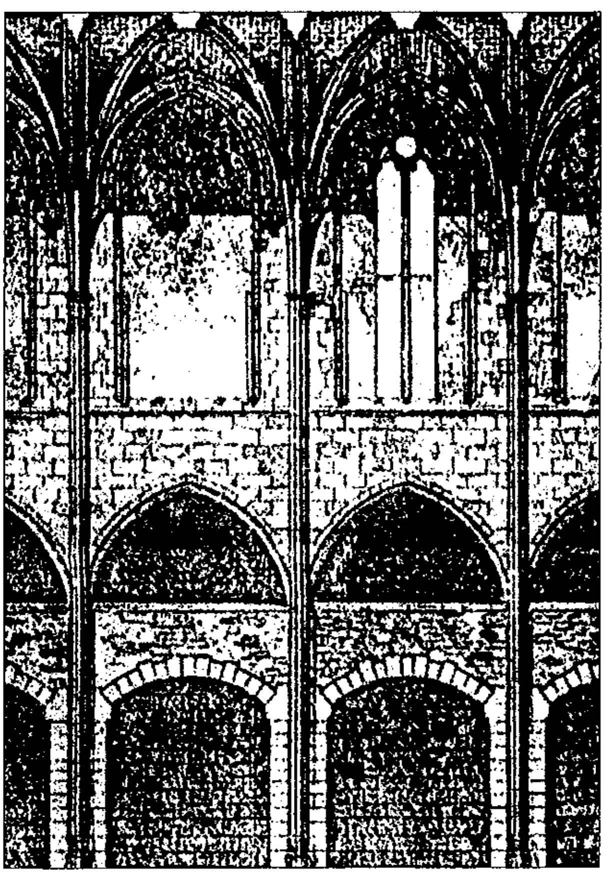


Figure 13. Elevation of nave wall.

building upon his prestigious role in the peace negotiations, obtained permission from the Bishop of Agde to build a new church at Valmagne, that which stands to this day. The abbey had actually already begun to raise funds for the new construction some years earlier, when it received a legacy from the Bishop of Beziers and a donation from the King of Aragon. Architectural details (tracery, molding, etc.) on the inside of the church would indicate that much of the building occurred in the last quarter of the thirteenth century and continued into the fourteenth century, as evidenced by the style of the capitals of the upper parts of the church and the decoration of the porch.

The new church's ground plan is similar to the Cistercian cathedrals of Longpont, Royaumont and Ourscamp. It has a basic basilical plan (See Centerfold) in the form of a Latin cross: a central nave flanked by two side-aisles (seven additional chapel-bays along the north side) and crossed by a short transept. East of the transept is a choir with its rectangular bays and an apse in ambulatory form with seven radiating polygonal chapels. The aisleless transept barely projects beyond the choir bay walls; this may have been due to the still functioning twelfth-century cloister on the south side of the church. And a sense of architectural symmetry would have demanded a similar abbreviated transept on the north. Rose windows (See Figure 12), now largely either filled in or their original stone and glass decoration damaged, pierce the north and south transept walls and the western nave (entrance) wall.

The two-storied (instead of three-storied) elevation of the nave walls (See Figure 13), while slightly uncommon in northern Gothic architecture is more common in early Cistercian and southern Gothic architecture. We must remember that the lower arch was filled in during the nineteenth century with the half-wall and round arch beneath which the wine casks were placed. The original nave wall extended from ground level up to the pointed arch. The clerestory windows rest directly atop the lower arch, with no intervening triforium level. Moreover, the clerestory windows do not occupy the full space between the piers but are braced in by panels of plain ashlar masonry (See Figure 14).

The building of this new church and the maintenance of the enormous staff employed in the endeavor put a financial burden on the community. The burden was alleviated somewhat when, in 1274, the abbot Jean III received the right to collect the toll on the Lunel Bridge along the so-

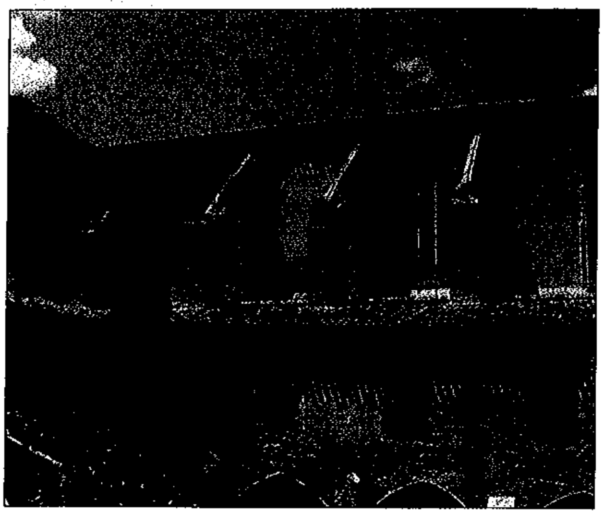


Figure 14. Note in central clerestory window the stonework which would have been braced in by panels of ashlar masonry.

called "Salt-Makers Way" connecting Frontignan and Nimes. But further funds were required to construct new cloisters, as it became apparent that the dimensions of the old cloister did not suit the new church. The new cloister was begun in the early fourteenth century and incorporated parts of the old cloister, including: on the east, the *armarium*, the sacristy, the chapter room, and the scriptorium; and on the west, the quarters of the lay brothers.

But hard times were about to descend upon Valmagne. At the beginning of the fourteenth century a terrible famine ravaged Europe, followed by the Black Plague in the middle of the century. Many monasteries fell into decline as the monks fled the plague, and when the monks returned, they usually had little inclination to uphold the austerities of the Rule. The Hundred Years War (1337-1453) continued to wreak havoc throughout the land, and even during periods of comparative peace the countryside was terrorized by roving bandits. During this period the Abbey of Valmagne was fortified to ward off brigands. To add insult to injury, Valmagne began to lose its lands little by little over the century as these were enfiefed to various lords and vassals of the king.

The fortunes of Valmagne did not improve much in the following century. Valmagne, like many of the other French monasteries, was in a state of administrative chaos. Traditionally, the abbots had been elected by a vote of the monks, but in the year 1477 Valmagne was placed *en commende*, which meant that the abbots would henceforth be named by the King, in an attempt to assure proper management of the abbey.

During the last half of the sixteenth century the Abbey was subjected to further deprivations. Around 1560 the entire region was immersed in the Religious Wars between Protestants and Catholics. In 1571 Mass ceased to be said at Valmagne when the abbot left the monastery and joined forces with the Protestant reformers. The renegade abbot took to raiding the nearby villages and in 1575 led an assault against Valmagne itself, killing many of the monks and those villagers who had sought sanctuary within the church walls. Shortly thereafter, records indicate that Valmagne was wasted, abandoned by the monks, and given over to the bandits; it was very nearly razed by Damville, the governor of Languedoc, in his attempt to bring order to the region. Valmagne survived, but in a sorry state. The glass in all the windows, including the rose windows, had been broken. Furthermore, the Chapter had decided to sell off much of the estates of the Abbey.

It would be nearly a century before Valmagne recovered even a little of her former splendor. But it was first necessary to shore up the unstable parts of the monastic structures. In 1624 the apse of the church was repaired by Jean Thomas, the Master of Works who constructed the Herault Bridge and the Pezenas Market. In 1635 most of the windows were closed up to prevent further deterioration to the structure (See Figure 15). The Guers and Vairac families, regional notables, contributed heavily to Valmagne's restoration; they were rewarded with their family crests being placed about the abbey.

During the second half of the seventeenth century Valmagne came to be controlled by abbots of

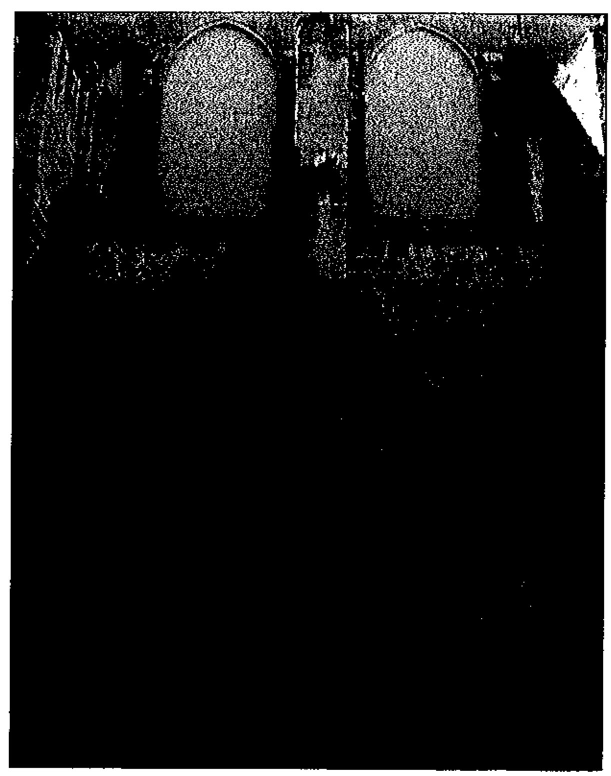


Figure 15. Southern clerestory windows were bricked up in the seventeenth century to prevent further deterioration of the structure.

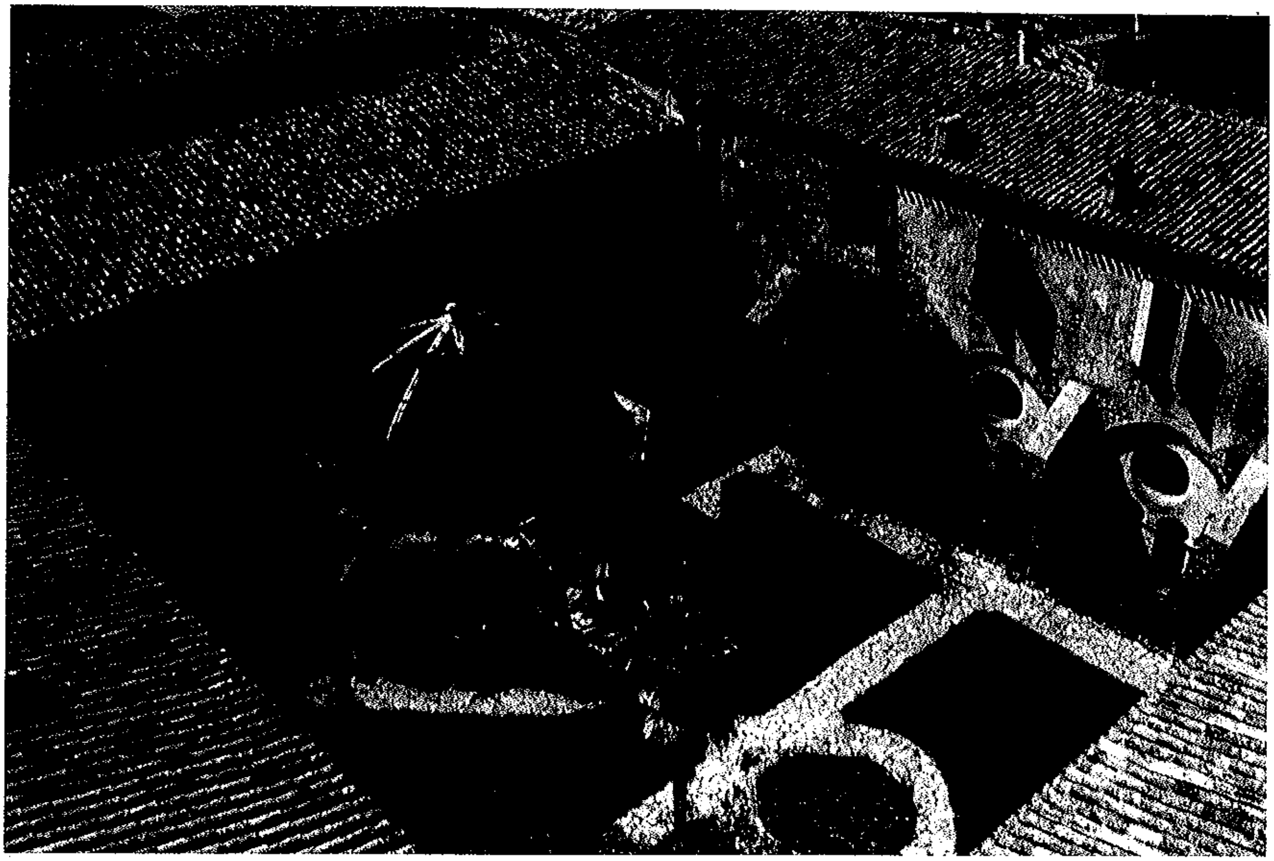


Figure 16. Cloister garden, with fountain in center.

Italian origin. The first of these, Victor Siri, was a friend of the famous Cardinal Richelieu. Siri spent little time at Valmagne, handing over the day-to-day running of the abbey to the prior, Dom Maffre, who continued the restoration work. Dom Maffre began rebuilding the western gallery of the cloister in 1663, and his name is inscribed under one of the vaults of the refectory. Cardinal Pierre de Bonzi, a Florentine nobleman, administered Valmagne between 1680 and 1697. This brilliant ecclesiastic had been named bishop of Beziers by King Louis XIV, and had served as an emissary of the King to Venice, Poland and Spain. He was later named archbishop of Toulouse and became a cardinal in 1672.

Cardinal de Bonzi is said to have reigned in Languedoc as a virtual king, and turned Valmagne into his palace. He added another story to the cloister and turned the dormitories into a vast corridor of rooms with an alcove and oratory. His personal parlor overlooked French-style gardens (See Figure 16), inspired by the Cardinal's frequent visits to Versailles. The splendid fountain in the south side of the cloister garden was probably given its final form at this time.

Cardinal de Bonzi's successor, his nephew Armand-Pierre de la Croix de Castries, continued the lavish lifestyle of his uncle. Such was the extravagance that by the time of the Revolution the abbey was heavily in debt. In addition, the monastery had less land attached to it, and fewer lay brothers to work the land as the community declined. By 1786 there were only six monks left at Valmagne, plus some servants and an altar boy. In 1790 the last four monks fled, just ahead of rebellious peasants who invaded and ransacked the abbey, burning precious documents, furnishings, and works of art.

As with most of the other monasteries in France during the Revolution, the abbey and its remaining dependencies were nationalized and sold. On May 23, 1791 Valmagne became the property of a certain M. Granier for the sum of 130,000 pounds. M. Granier resumed cultivation of the vineyards and is responsible for turning the church into a wine cellar, with the addition of the huge casks (some still in use today) in the nave and apsidal chapels of the church (See Figure 17).

In 1838, following the death of M. Granier, the abbey and its dependencies were sold again, this time to Henri-Amadee-Mercure, the Count of Turenne. The abbey was completely restored during the second half of the nineteenth century, and remains to this day in the possession of the descendants of the Count of Turenne.

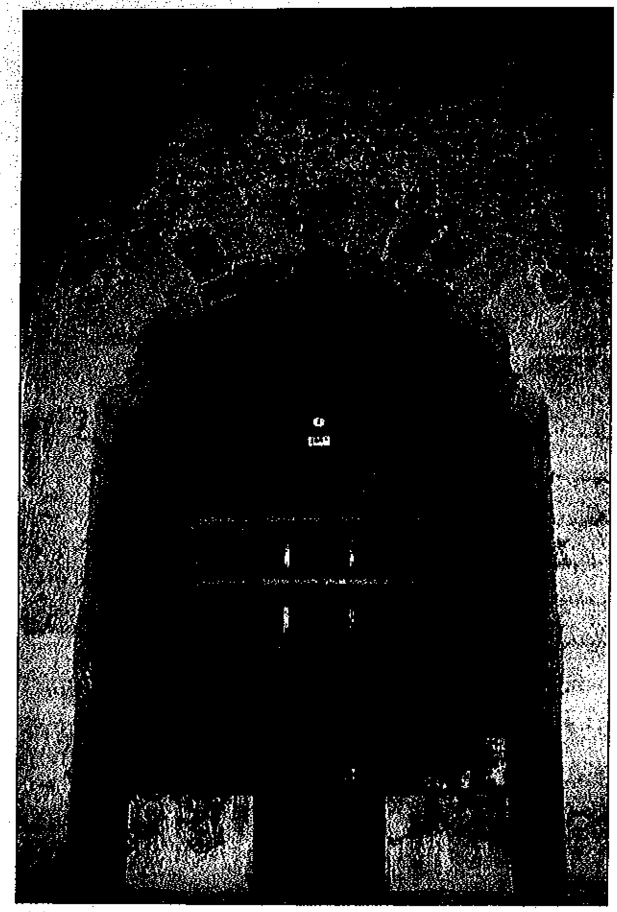


Figure 17. Oak wine cask in nave chapel.

In modern times the Domaine of the Abbey has remained a producing vineyard, and its wines are achieving much recognition. Concerts are held in the restored refectory of the abbey (See Figure 18). The apartments of Cardinal de Bonzi, restored and furnished in the style of the Cardinal's times, serve as the private apartments of the owners. The abbey has been open to the public for visits since 1975.

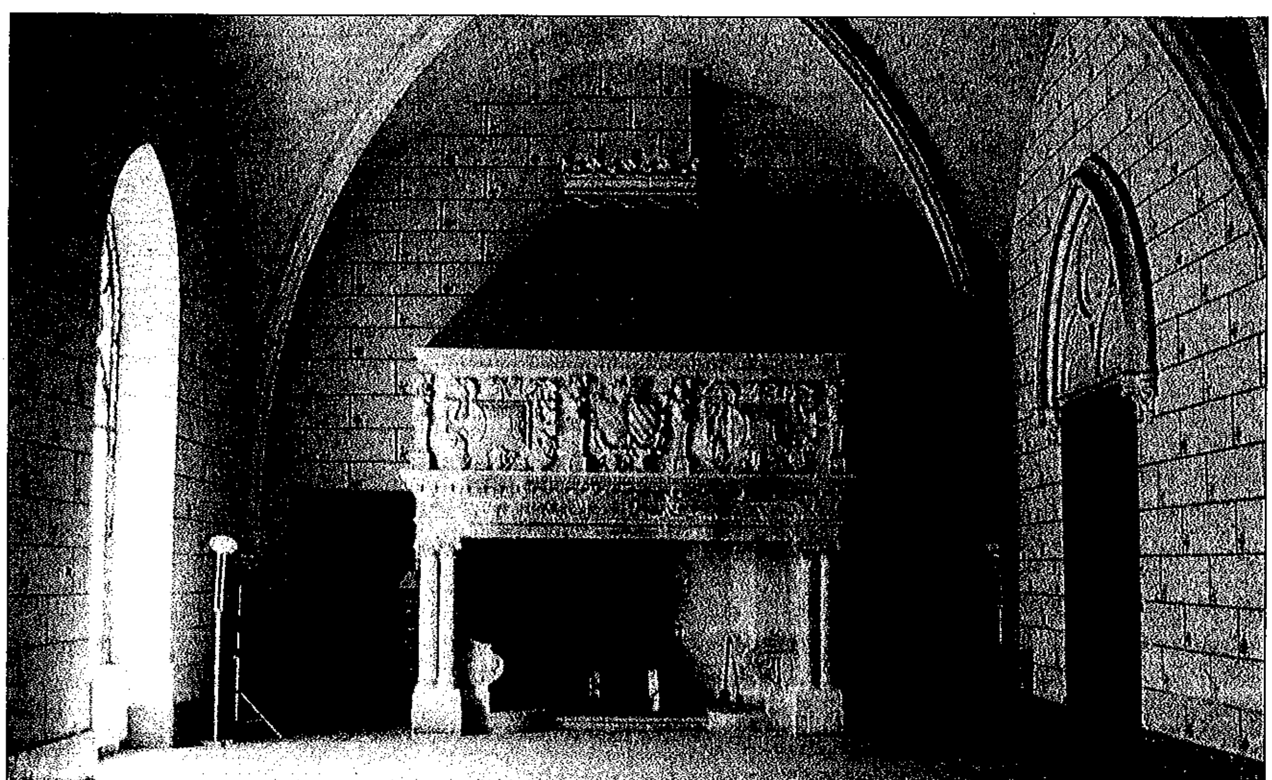


Figure 18. Refurbished refectory.

The Buttressing of the Abbey Church of Valmagne
by Vivian Paul and Robert Warden

The second abbey church of Valmagne was constructed in the late thirteenth and early fourteenth centuries. Its plan is related to the Cistercian cathedral plans of Longpont, Royaumont, and Ourscamp. Stylistically it belongs to the austere Rayonnant Gothic style of southern France, which includes such structures as the cathedrals of Narbonne, Toulouse, Rodez, Limoges, and Clermont-Ferrand. The eastern portion of the building, particularly the radiating chapels, closely resembles the corresponding portions of the cathedral of Limoges.

Valmagne, however, is not as tall as those Rayonnant cathedrals with which it can be compared stylistically. At about 24.5 meters high to 10.83 meters clearspan (plus wall thicknesses of .82 meters), the building is almost one-to-two in width to height. That, of course, would be a nice Cistercian proportion, but not necessarily one that is particularly advantageous structurally. Since horizontal thrusts increase geometrically with the width of the clearspan, the forces exerted by the vaults on the walls of the building were apparently too great for the supporting mechanisms of the church, especially considering the thinness of the upper walls of the building (approximately .62 meter). These clerestory walls splay outward quite visibly. There is no way to tell precisely the date at which this deflection occurred, but suspicion is that it probably happened early on in the building's history.

The major alterations which were made to the building between the sixteenth and nineteenth centuries are likely to have had a positive rather than a negative impact on the stability of the structure. The filling in of the clerestory windows (See Figure 15) after they were destroyed in the Wars of Religion, for instance, should have provided additional reinforcement for the clerestory level. The walls built between the piers of the nave and aisles to create individual spaces for the large wine barrels, installed when the abbey was turned into a winery, may have also provided some reinforcement at the level of the main arcade windows (See Figure 17). Neither of these two alterations, however, was sufficient, and at best only postponed the ultimate collapse of one of the buttresses. During a tremendous storm in the nineteenth century, the first buttress from the west on the south side of the nave gave way, taking with it two bays of the clerestory on the south, a considerable portion of the vaults in the first two bays of the west end of the nave, and a portion of the vaults in the adjoining south aisle (See Figure 19). All that remains of the buttress is the pier and the first courses of the flyer at the point where it begins to depart from the pier (See Figure 20).

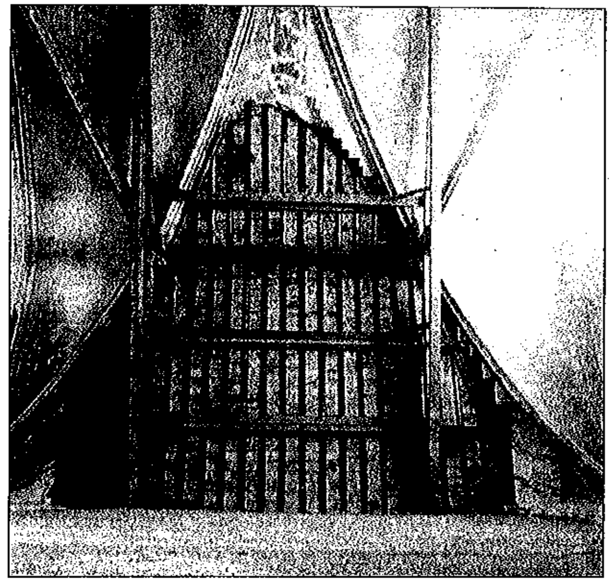


Figure 19. Section of destroyed vault covered with wooden roofing.

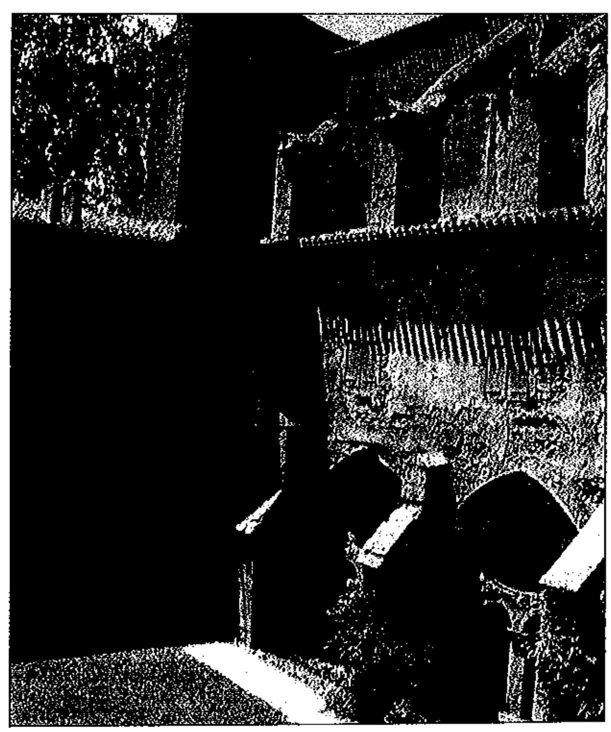


Figure 20. Notice destroyed flying buttress on upper level.

The structural problems and anomalies of the abbey church are, for those interested in the history of construction and structure, one of the more fascinating aspects of the building. For example, each buttress has only one flyer, probably because the building is not so tall as, for instance, the cathedral of Narbonne. Nonetheless, it brings up the question of how medieval masons determined the placement of buttress flyers, particularly when it was a single flyer. Several other questions come to mind. At what point in the construction of the building did the displacement of the nave clerestory take place? What aspects of the building design caused or allowed the walls of the nave to deflect in the first place? What caused one of the buttresses ultimately to fail and more specifically, what caused only that particular buttress fail? Why did not the other buttresses fail, particularly since the deformation of the walls occurred in more than just one bay along the entire length of the nave? The goals of the expedition to Valmagne were, first, to examine various aspects of the buttressing design in order to determine what might have distinguished the buttress that failed from the other buttresses; second, to test our conclusions scientifically, using finite element analysis; and third, to gain a better understanding of the degree to which medieval masons understood the elements of structure.

A rib-vaulted Gothic building is a complex structure. Its stability depends upon the interaction of many factors. The type and quality of the foundations of the building and the buttressing system, for instance, are important for questions of subsidence. The size of the bays and the width of the clearspan will affect the amount of masonry per bay and, hence, the amount of horizontal force concentrated against the walls. The types and weights of material will also affect the amount of horizontal force; denser materials weigh more and increase the loads produced by the vaults. The thickness of the vault shell will also affect the weight and hence the loads produced. The size of the clerestory windows, that is, whether or not they fill the entire space available to them or whether they are framed by a panel of wall to either side, as at Valmagne, is also important. A panel would help reinforce the wall at the point where the horizontal forces are concentrated, and at least some of those forces are likely to be absorbed by corbelling action into the wall. The thickness of the wall at clerestory level would also be a critical factor; the thicker the wall, the greater its resistance to overturning. The height of the building and the curvature of the vault shell will affect the point and the angle at which the horizontal loads produced by the vaults hit the wall. The extent of the vertical loading (above the vaults and over the windows) will affect the amount of horizontal forces produced and the way in which they are delivered to the buttress pier. The dimensions of all elements of the buttress, the points at which the buttress flyer (particularly the straight part) hits the clerestory wall and joins the buttress pier, as well as the angle of the buttress flyer will affect the distribution of forces within the buttress and the ability of the pier to control or counter the horizontal loads. Last but not least, the force of the wind upon the building will affect the amount of horizontal load that must be controlled by the buttresses. Changes in any one of the factors will affect the delicate interplay of forces within the entire structure. Whether or not a particular change would affect the stability of the building depends upon the degree of the alteration and the degree to which other factors compensate for any adjustments. It is our hypothesis that the most critical factors that led to the failure of the buttress at Valmagne involved the design of the buttresses and their flyers, although this is not to deny the contribution of other negating factors.

Valmagne is not particularly tall, but it is relatively wide for its height. It is constructed from coarse, fossiliferous local limestone. The dimensions of the bays are consistent. The clerestory walls are thin. And the vault shell, too, is relatively thin. (The roof at Valmagne has been restored. As it is now, it skims the back of the vaults in such a way that it is impossible to penetrate beneath the roof windows (See Figure 19). Hence, there is no way to determine exactly how much rubble loading may have been used or if there are small "walls" resting on the backs of the transverse arches.) Most important, there is only a single flyer for each buttress (See Figure 21). This means that each buttress must do double duty in terms of countering or controlling both the horizontal loads produced by the vaults and those resulting from wind loading.

Close measuring and documentation indicate considerable variation in the design of the buttresses, both between the northern and southern buttresses and even between those on the south side of the nave itself. Most immediately apparent are the dimensional differences in the flying buttress piers on the two sides of the naves; those on the north are thinner and deeper than those on the south windows (See Figure 22).

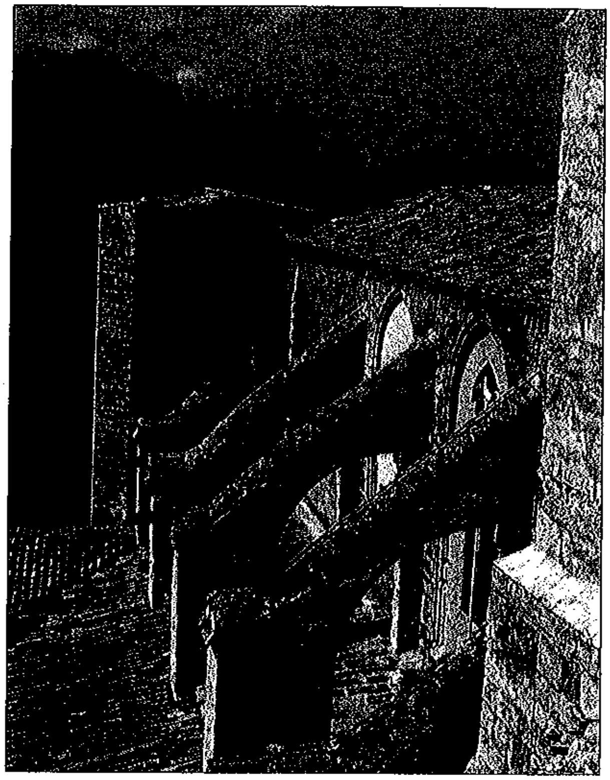


Figure 21. Flying buttresses from clerestory of abbey church.

Figure 22. Buttresses on the north side of the abbey church.

The fact that the church was likely to have been built against a pre-existing cloister helps explain the depth of the southern buttress piers, but it does not explain why these buttresses are thicker than those on the north. We would suggest that the masons, intuitively understanding the way in which buttresses worked, compensated for the lack of pier depth by making the piers thicker. That is, they assumed that increasing the thickness of the buttress would increase the amount of masonry and hence the resistance of the pier to the horizontal forces carried outward through the flyer. It is true that increasing the width of the buttress pier would have increased the amount of masonry and the effectiveness of the pier. Despite the increase of masonry, however, the total amount of masonry in the piers of the southern buttresses would never have been equal to the total amount of masonry in the buttress piers of the northern side, simply because the depth of the northern buttress piers is so much greater. By dint of sheer mass, the northern buttresses would be stronger. What is interesting is, that despite these differences, the distortion of the clerestory walls is not noticeably less on the north side of the nave than on the south side.

The question remains, therefore, whether such a slight increase in width in the southern buttress piers would have significantly altered the ability of the buttress pier to withstand the horizontal forces delivered to it. Given the evidence of the building, the answer is a conditional "yes." Increasing the thickness apparently did work for the piers on the south side of the nave in the last five bays, but not for the buttress pier between the first and second bays. There the buttress failed (See Figure 23).

Figure 23. Failed buttress.

Therefore, neither the depth nor the thickness of the buttress pier alone, nor the two in combination, were sufficient to prevent the failure of this pier. There had to be additional factors at work.

One additional feature in the design of the surviving piers on the south side that distinguished them from one another and from the northern piers is the distance between the straight portion of the flyer and its supporting arch, i.e., its thickness. A buttress flyer has two major parts: the straight portion that slants outward and downward between the clerestory wall and the pier (generally at an angle near 45°) and the arch that supports the straight portion. It is the straight portion of the flyer that conducts the horizontal thrust outward and downward onto the piers. In the case of the buttress pier between bays two and three on the south, this distance is less than it is for the other flyers on the south side and for any flyers on the north. This means that the distance is likely also to have been less at points where the flyer intersects with both the clerestory wall and the buttress pier than it is for the other buttress piers. The pattern of construction campaigns in the upper parts of the church suggests that the flyers of the two westernmost buttresses are contemporary (See Figure 21). This would mean that the two western buttresses may have been comparable in terms of their thickness, depth, and configuration of their flyers. This would imply that the flyer of the first buttress may also have been less deep than the others. Keep in mind, however, that only the first buttress failed, so the distance between the arch and the straight piece of the flyer alone or even in combination with the dimensions of the buttress pier cannot be the reason for the failure. There must have been something else that in and of itself or that in combination with other factors in the buttress design would have caused the buttress to fail.

Let us look at two other factors that are likely to have affected the ability of the buttresses to control the horizontal forces produced by the vaults: the points at which the flyer (particularly the straight portion of the flyer) hits the clerestory wall and at which it joins the buttress pier.

The point at which the straight portion of the flyer hits the clerestory wall is critical because this is the juncture that must be correlated with the point of greatest concentration of forces on the interior in order to ensure an effective transfer of horizontal forces to the flyer. The point at which the flyer hits the wall is particularly significant in a building in which there is only one flyer, because of the fact that each individual flyer must control both the vault forces and the forces produced by wind loading. At Valmagne the straight portion of the buttress flyers generally hits the clerestory wall approximately ten centimeters lower on the south side than on the north.

The point at which the straight portion of the flyer hits the buttress pier is also important. This point can affect the distance between the arc and the straight piece of the flyer, the slope of the flyer, and the height and angle at which the horizontal forces actually hit the buttress pier. It can also affect the amount and location of the masonry in the pier available for vertical loading, providing that the height of the buttress pier was not altered. All the flyers on the south side are steeper than those on the north. In the failed buttress, this point where the straight part hits is higher than it is for the second pier, which did not fail, but the pier of the failed buttress is also less tall than its counterparts. This strongly suggests that the amount of masonry acting as vertical loading in the failed pier was not sufficient. As it is, the horizontal forces produced by the vaults were clearly too great for this one particular buttress whose design differed in significant ways from the designs of any other buttresses in the building.

We would like, therefore, to suggest that the primary reason for the failure of the buttress is in the design of the pier at the point where the straight portion of the flyer intersects with the pier. This suggestion is supported by the manner in which the buttress ultimately failed, and the pattern of cracking that can be seen in the two succeeding buttresses on the south side. Quite simply, the flyer slipped or sheared along the coursing of the masonry at the point where the horizontal plane at the top of the buttress pier intersects with the vertical plane facing the clerestory wall and the straight back of the buttress flyer.

By comparison with the flyers and piers of the buttresses for the nave, those of the chevet are considerably overbuilt (See Figure 24). This is in spite of the fact that the amount of thrust delivered to each buttress in the hemicycle, given the total area of each of these vault sections, would have been considerably less than the thrust delivered to each of the buttress piers in the nave. Yet for each of these buttress piers the proportionate ratio of width to depth is considerably greater than it is for any of the nave buttress piers; so too is the distance between the straight portion of the flyer and the arch that supports its flyer at the point where they

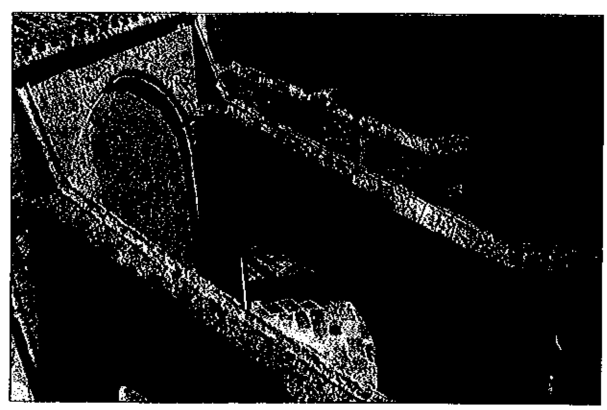


Figure 24. Flying buttresses of chevet.

intersect with the wall of the clerestory considerably greater.

Why this discrepancy? That is, why is there such overbuilding in an area where it was not critical and underbuilding in an area where it was? Part of the answer must surely lie in the experience of the individual masters responsible for the different portions of the building, as well as the availability of funding. The overbuilt portions are among the earliest parts of the building, where the influence of the Limoges cathedral is most evident, and funding most adequate. The significantly underbuilt portions were among the last portions of the church completed, at a point when, given the restricted size of each identifiable construction campaign, funds must have been dwindling and construction slowed.

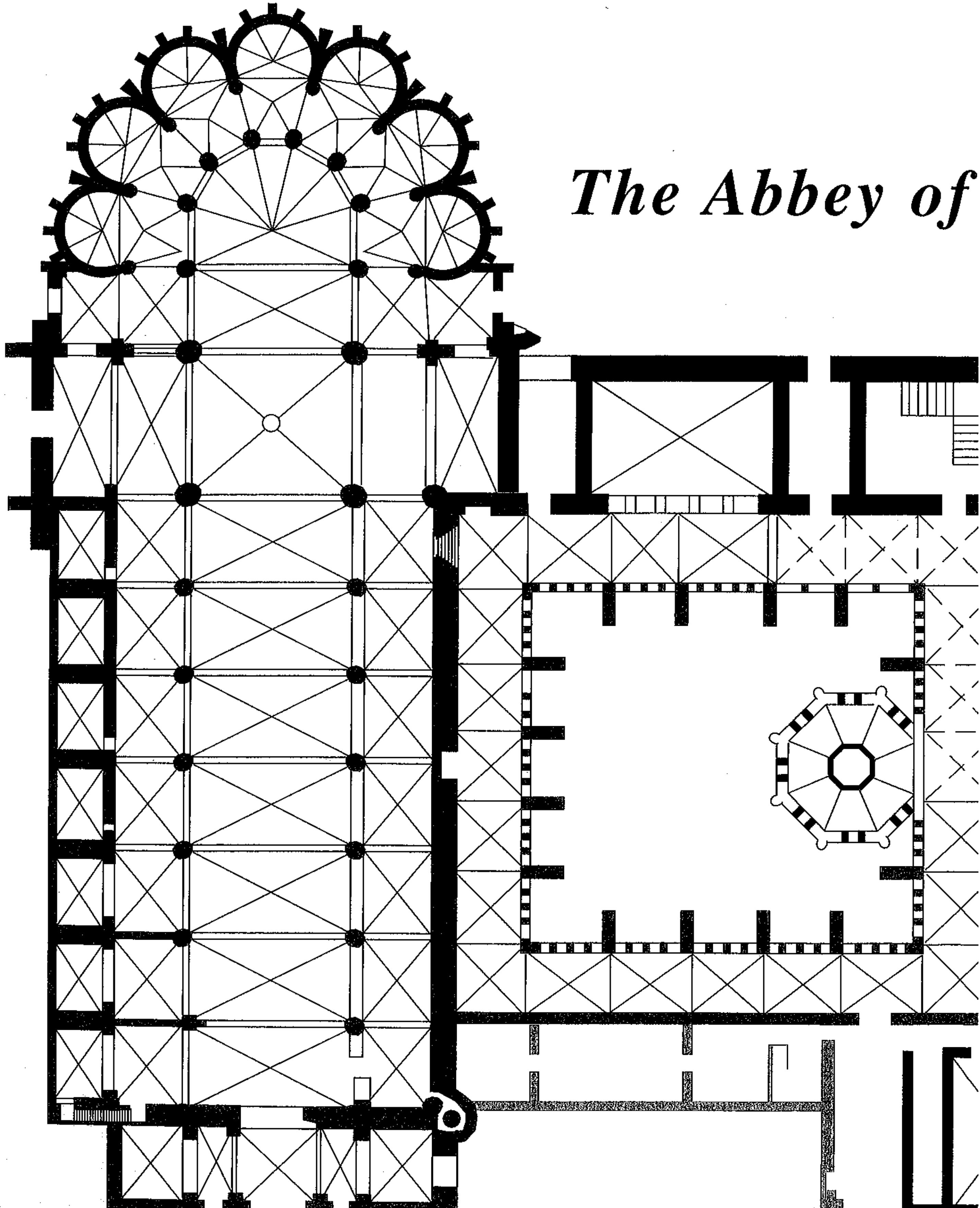
SURVEY METHODS
Part I: The Total Station
by Gene Ryan

The basic elements used in surveying historical architecture are essentially the same as are needed in its construction; namely: the measuring scale, the plumb line, the circle, and the triangle. The metric system is almost universal today; whereas, in the Middle Ages, each separate guild working on the same building might have used a measurement system different from that of their co-workers, making the job of co-ordination slightly more complex. The plumb line is required for determining a true vertical. The circle is used not only as a design element (for its intrinsic symmetry), but also, as the drawing compass, for transferring measurements and constructing triangles, rectangles, and squares. The primary layout and surveying figure, however, is the triangle. Whether first laid out as a square or rectangle through which a diagonal is drawn, or as right-angled triangles combined into squares and rectangles, triangles are the cornerstone of construction and survey. Unlike a rectangle, which can be bent out of shape easily, a triangle can be deformed only by breaking one of its sides or corners.

This very dimensional stability also means we can use triangles to calculate the dimensions of things that are otherwise physically inaccessible. The theory is simple: a triangle has six elements: three sides and three angles. Knowing "three in a row" (angle-side-angle or side-angle-side) allows any and all other elements to be calculated. For example, to measure an inaccessible point, a "target point" on the top of a building, we locate the point directly below the target point (forming a 90° right-angle, by definition) and measure the horizontal distance to our surveying equipment ("the side") where we read out the angle of elevation ("the other angle"). We now can use our trigonometry tables to determine the exact height.

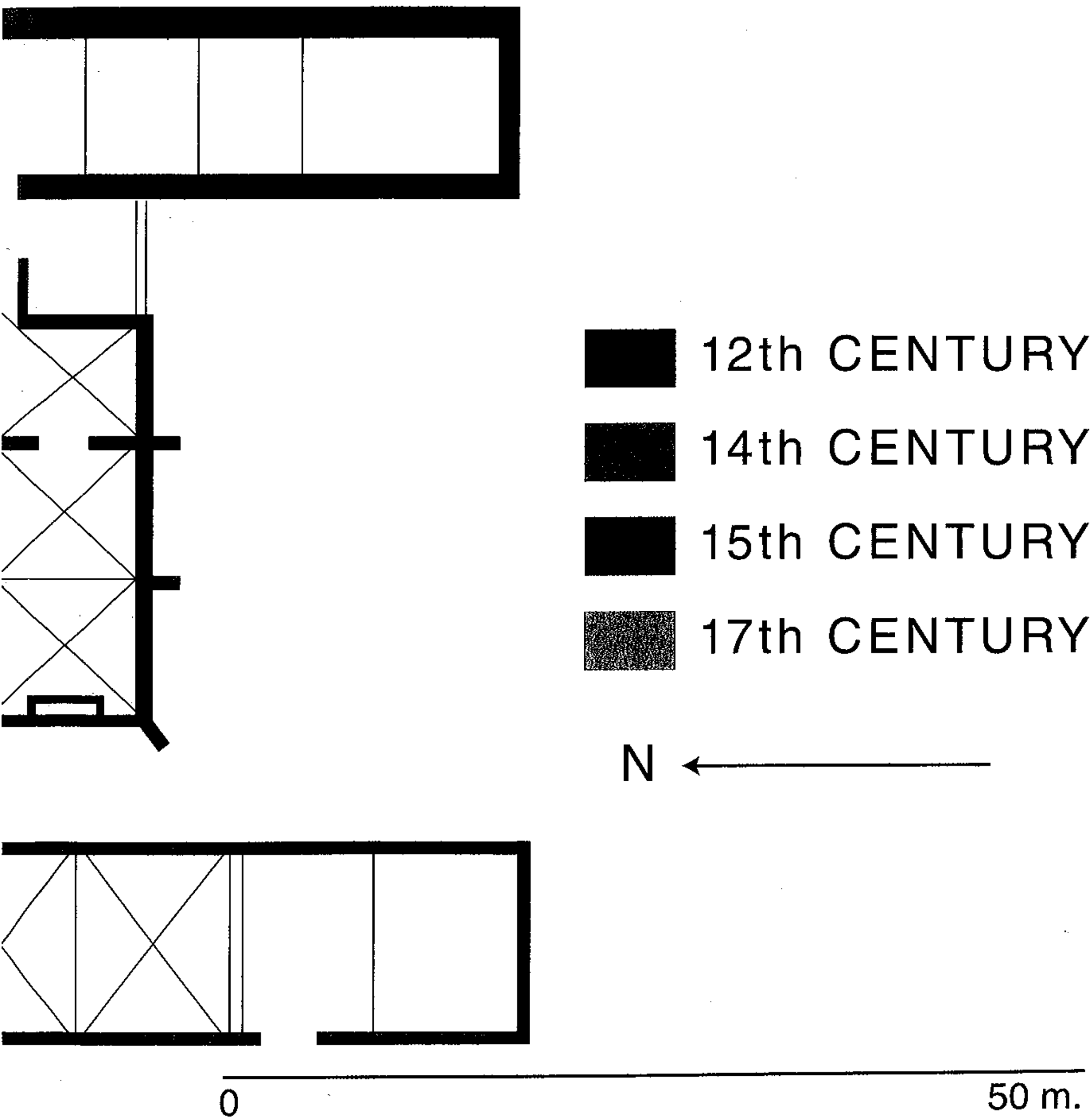
In the twelfth century, however, they would have had to take an extra reading, because while trigonometry tables were known in the Islamic world, they were not known in Christian Europe. The following is one way a reading could have been taken in medieval Christian Europe without the advantage of the trigonometry tables. Pick a spot exactly one measurement unit in front of the sighting device, stick in a spear in the ground at that point and sight horizontally past the spear to the ground point below the target, thus finding the "zero point" on the spear. Then run a scale up the spear until the top of the scale just obscures the target point. You can then calculate the height of the target point by simply multiplying the scale reading times the horizontal distance.

Here is how surveying looked at the Abbey of Valmagne (Figure 25). In an ideal situation, which Valmagne was not, Harriett would measure the height at (H) simply by lowering a measuring tape



The Abbey of

Sainte Marie De Valmagne



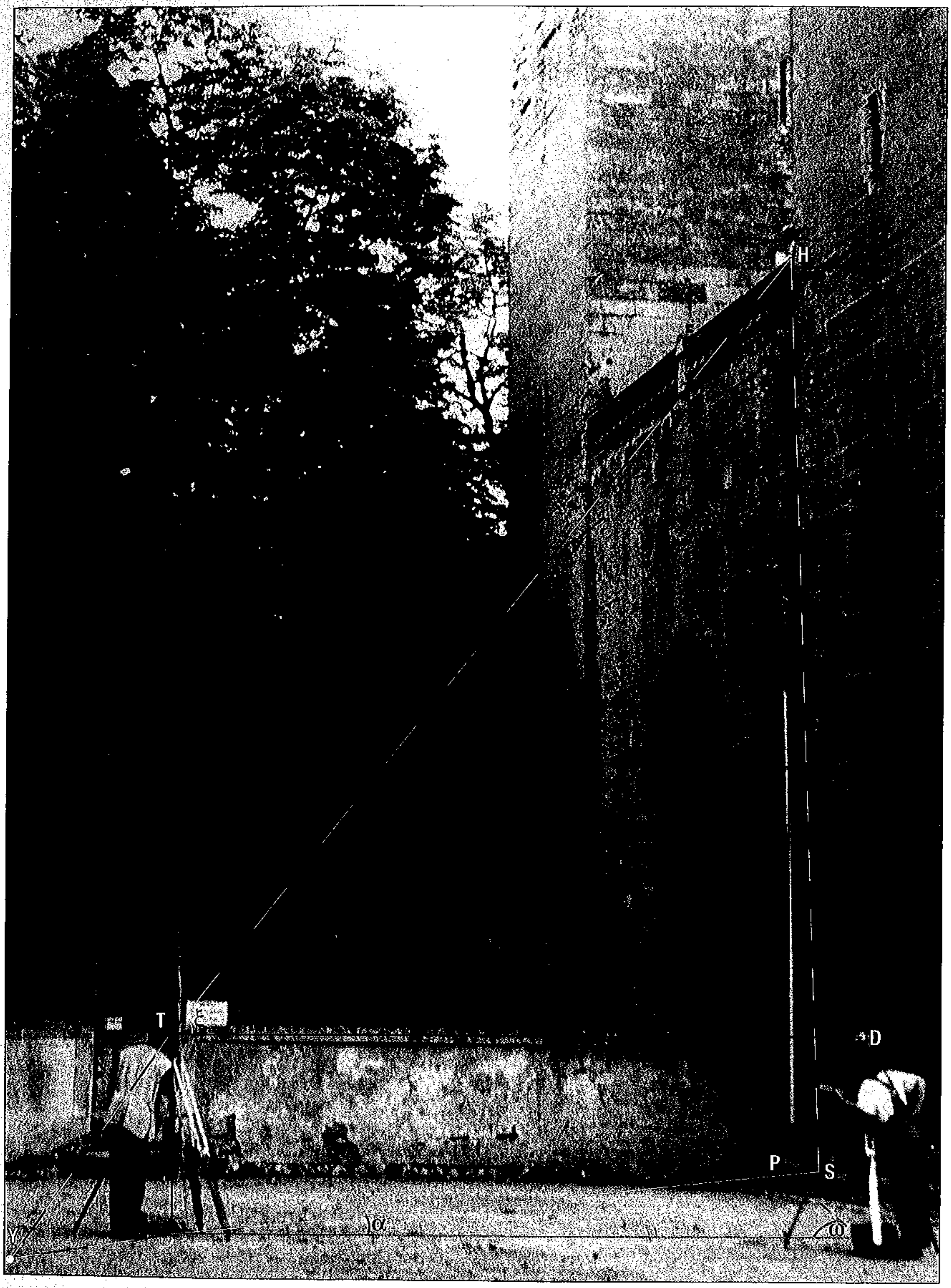


Figure 25. Surveying at Valmagne.

down a perfectly vertical wall. The operation then would be repeated at one meter intervals, marked off along a perfectly horizonal ground line. But when Harriett used a fixed-length plump line at intervals along the terrace, it hung about half a meter away from the wall, e.g. at (P), and at varying gaps above the ground – meaning the wall is not vertical and the ground is not horizonal.

That called for a "Plan B." Harriett, still on the terrace, holds a white arrow at the target point (H). By tilting the viewing instrument, we find a second point (S) at the base of the wall below Harriett, where Shahnaz holds one end of a meter tape. We calculate Harriett's position by measuring the horizontal distance, through (P), to the transit (T) where Tom sights the points, and determines the appropriate angles. Once his instrument has been leveled, reading the elevation angle (ξ) is as simple as the theory indicates, but unfortunately, nothing else is. Because the instrument is not on the ground, Tom hangs a plumb line of his own (solid green) to locate the point below it, to use as a reference for the horizontal distance (solid yellow), and also for measuring the height of the viewing telescope above the ground. (Surveying equipment has precision hooks and marks for doing this accurately.) But we are now actually measuring the entire yellow triangle (HSY) formed by Harriett, Shahnaz and the yellow tape-roll (on the ground behind Tom) and then subtracting out the green triangle formed by the tape-roll, transit barrel and plumb line. But remember, the wall of this six-hundred-year-old building leans towards us a little, so that the height must actually be measured down Harriett's (purple) plumb line, not directly to Shahnaz - i.e., by calculating a third triangle (HPS).

Eyeballing these anomalies is precise enough for laying out a road or viaduct, and is within the accuracy limits of the astrolabe or groma that might have been used in ancient or medieval times. However, we can be much more accurate today with precision equipment and computers. Debbie sets up a duplicate transit (D) at exactly the same height as Tom's. (He sets his instrument precisely to horizontal and then sights through it to the "vertical precision mark" on Debbie's. She uses the vertical crank on her instrument to line it up exactly with the cross hairs in Tom's scope.) Now, our accuracy is only limited by how precisely we measure the distance (dark blue) between the two instruments. This line, projected down to Tom's ground mark, is called the "base line" (light blue), and the direction from Tom to Debbie is defined as zero degrees in the horizontal plane. No other distances need be measured, Tom and Debbie simply target multiple data points (e.g., Harriett) and record their elevation (vertical) and azimuth (horizontal) angles. A two-step calculation then determines the 3-D co-ordinates, so while the setup can take a little time, the better to ensure accuracy, a large amount of data can be acquired quite rapidly afterward.

Determining the co-ordinates of (H) requires first a horizontal calculation to find the co-ordinates of (P), half a meter from Shahnaz, directly below Harriett, then a vertical calculation up the plumb line to (H) itself. The "Angle-Side-Angle" of Tom's azimuth (α), the base line itself, and Debbie's azimuth (ω), shown in light blue in Figure 25, determines the direction and distance (or "vector") from Tom's transit to Harriett's plumb line. That vector connects Tom's elevation angle (ξ) with the vertical right angle (90°) at Harriett's plumb line, comprising the "Angle-Side-Angle" needed for the second step.

The instrument used most often at Valmagne was the Total Station, which, in addition to the standard surveying telescope with levels, fine controls and precision marks, also contains a computer (optimized for surveying), and an infra-red transmitter for measuring the (red) slope, or "line-of-sight", distance instead of the (yellow) horizontal distance. This eliminates tape handling and calculation errors. Instead of carrying a tape, Harriett can hold a corner prism on the target point (H) and the Total Station converts the readings, in one step, into a set of "north, east, and height" co-ordinates relative to the (light blue) base line. Moreover, only one instrument is actually needed - Debbie could collect the necessary readings from "Tom's position," reposition her Total Station, re-calibrate by taking a "back-sight" (i.e., measuring the slope distance and angles to "Tom's ground mark"), and then continue taking readings.

The key element that makes this possible is the corner prism, which has the desirable characteristic of reflecting light (including infrared) back in exactly the direction it came from. (If you stand directly in front of your bathroom cabinet mirror, you see yourself in the middle of the mirror. But if you move to one side, you no longer see yourself, but a different part of the room. Swing the mirror open and you can get your image back into the center of the mirror.) To translate this into surveying terms:

Harriett would have to hold the prism in one exact, unshaking position long enough to take a reading; a single reading, then, could take all day.

The solution is the corner prism. (Hold a flat hand-mirror vertically against and at right angles to the bathroom mirror and look into the pair of mirrors from approximately the center of the "V". Notice, when you move your head from side to side, you remain looking directly back into your own eyes (also left and right aren't reversed). Add a third mirror parallel to the counter top (at right angles to the other two mirrors) and any light sources within the 45° cone of these three mirrors will find its light being reflected right back to itself. Also, and equally important, the distance the light travels is the same no matter where on the mirrors it first strikes.) Therefore, a Total Station need only make a change in the phase of its outgoing signal, and then time how long before the return signal reflects that phase change, to be able to calculate the distance.

There is another bonus to the Total Station: its ability to establish a plane (the surface of the wall, for example) by shooting three data points (not in the same line) from a single station. We can then use the "Building Face Survey" program to acquire as much subsequent data as desired without anyone having to hold the prism (or scale the wall). Simply sight on the desired data point and press the "acquire" button on the computer -- the "three in a row" triangular measurements are: 1) the angle the plane of the wall forms with the ground (established by the three reference points and unchanged thereafter), 2) the horizontal distance to the Total Station (derived from the reference points by using the horizontal, or Azimuth, angle), and 3) the vertical (or Elevation) angle at the Total Station itself.

Part II: The 3D-Digitizer
by Gene Ryan

The 3D-Digitizer works on similar principles to the Total Station, but uses ultrasonic sound waves rather than infra-red light. There are, then, some differences. The large black triangle in the photo (See Figure 26) is actually a holder for three ultrasonic receivers mounted at its corners. The probe Bill is using emits a phase modulated signal that is received at slightly different times by the three receivers. The computer Eulah is using then calculates the position of the probe from the three receivers, giving equivalent distance values.

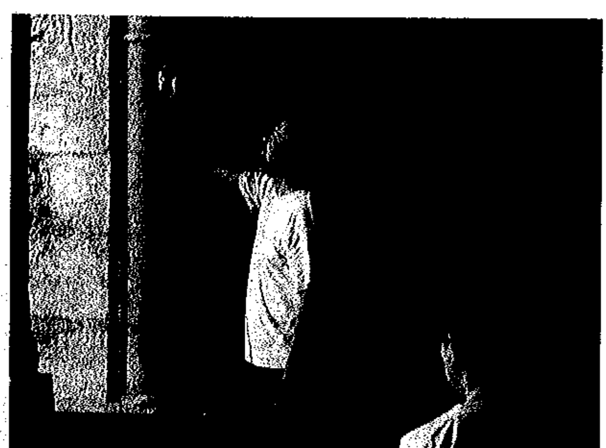


Figure 26. Using the 3D-Digitizer.

All points at the first distance lie on the surface of an imaginary sphere, centered on the first receiver, which intersects the similar sphere (of radius equal to the second distance) around the second receiver. Two intersecting spheres always define a perfect circle. And that circle intersects the imaginary sphere centered on the third receiver in exactly two points, one is the desired data point, and the other is a mirror image on the back side of the 3D-Digitizer. Taking multiple data points in sequence results in a segmented model of the surface that is being probed (See Figures 27 & 28).

As usual, the practice is not as simple as the theory. First, sound can be blocked, masked or distorted by other objects, by ambient sounds, or by echoes. Second, if the sender is on the tip of the probe, then trying to model a point inside a cavity will often result in a faulty reading. the solution is to put the emitter farther back on the probe, but then there is a second variable – at what angle is Bill holding the probe? A second emitter is therefore put at the very rear of the probe (two points determine a line) so that the orientation of the probe (which has a known length) can be determined

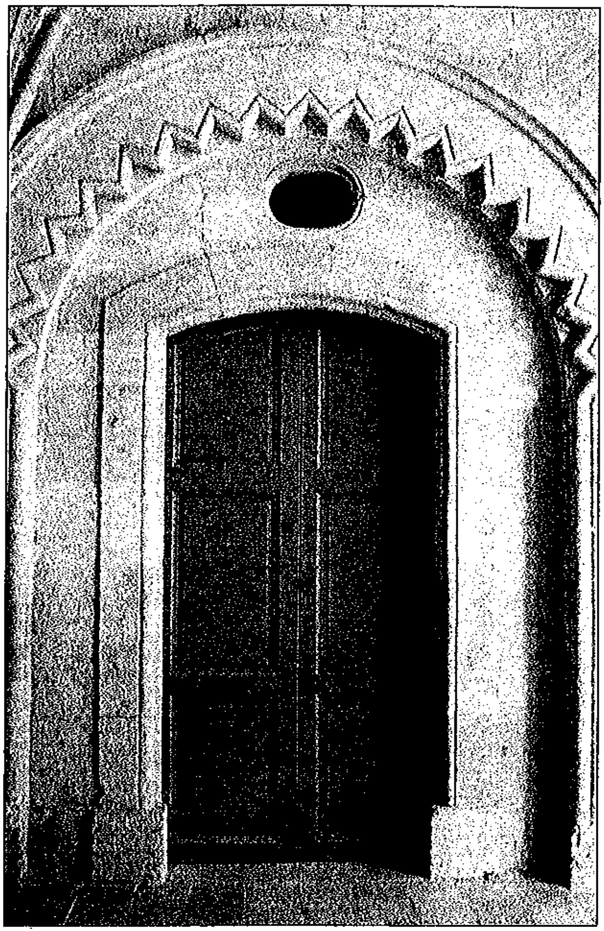


Figure 27. Doorway to the sacristy.

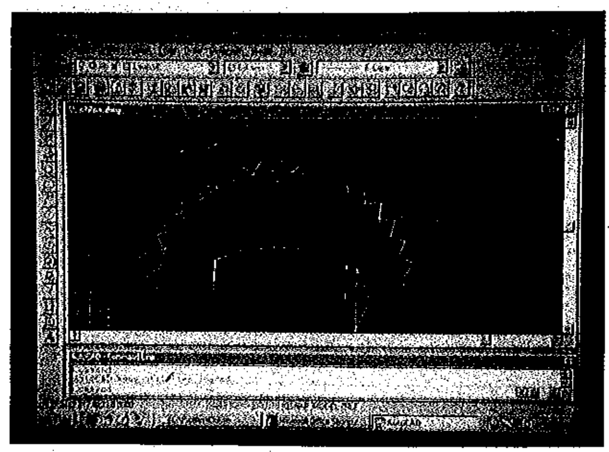


Figure 28. Digitized picture of sacristy doorway.

by the computer. Third, the speed of sound in air is heavily dependent on the ambient temperature and humidity, which can vary widely over the length of time it takes to collect the data. In this case, the solution is to put a reference bar (See Figure 26) of known length in front of the receivers on the triangle, and whenever the probe is triggered, emitters at each end of the reference bar also send their position data. In this way the probe is calibrated to a known length every time it fires. The emitters are distinguishable because they each use a different frequency.

The extremely echo-y environment in the church made it exceptionally difficult to get good readings; especially in areas with multiple columns, which are exactly the areas where it is most desirable to use this kind of technology. Such are the unexpected trials of the everyday archaeologist.

Part III: Close Range Photogrammetry
By Robert Warden

Close-range photogrammetry (CRP) is a by-product of the stereo photogrammetry technology that was developed for the defense department in an effort to accurately locate objects from aerial photographs. Where the earlier stereo photogrammetric systems required a large expensive machine with which to view and take measurements from photographs, close-range photogrammetry utilizes the newest technologies in digital image processing to work with photographs inside the computer. It is called "close-range" because the images are taken near the object - tens of feet away - instead of from an airplane or satellite (See Figure 29).

Figure 29. Photographing the vaults in the abbey church.

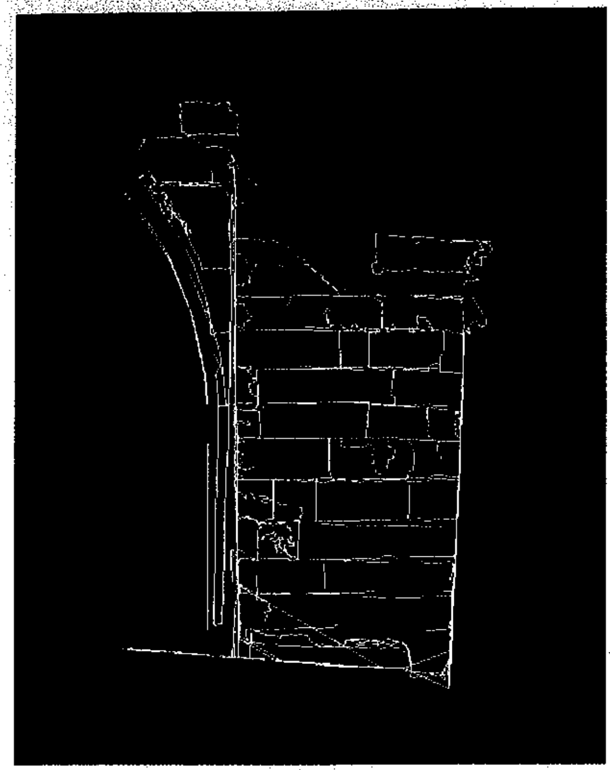


Figure 30. 2-D rendition of destroyed buttress.

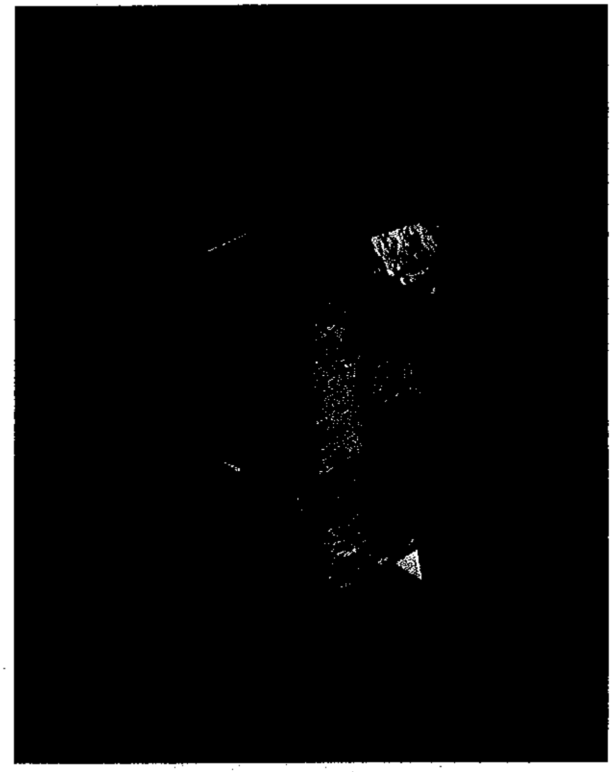


Figure 31. 3-D rendition of destroyed buttress.

CRP is a method of measurement that utilizes the optical mathematics employed in the lenses and film of cameras to calculated the position of an object in space. As we saw in the earlier discussions of the Total Station and 3D-Digitizer, the location of any point in space requires knowledge of either a distance and two angles (one horizontal and one vertical) from a single known location or three angles (two horizontal and one vertical) from two different known locations. CRP uses the second method to calculate the position of points on a building. photographs of the desired object are taken from many angles with a camera whose film format and lens focal length are known. Any good quality 35mm camera with a fixed focal length will work. The developed negatives or slides are scanned at high resolutions of a lest 3,000 dots per inch. these scanned images are used to provide computer software such as Photomodeler with information about the desired points to measure. If the same point on the building is chosen carefully in each photograph, Photomodeler can perform calculations to pinpoint the (x, y, z) coordinates of that point. The accuracy of these calculations is enhanced by placing targets on the objects that have been previously measured by a Total Station.

After calculations have been made, the modeling process can begin. Modeling is simply a matter of connecting the calculated points together with lines or surfaces depending on how the model is to be used. If traditional 2D drawings are desired, lines can be pulled from the model and printed (See Figure 30). If 3D models are required then texture information from the photographs can be applied to the model to make it look very realistic (See Figure 31).

The value of the Total Station is that with the prism one can accurately measure desired points from a single location. This saves time and effort. But the problem with the Total Station is that it is difficult to accurately measure the location of points without the prism. The "Building Face Survey" program partially compensates for this deficiency, but by working in unison with a Total Station, CPR can further refine the positions of points that are too difficult or dangerous to measure directly.

The Stones of Valmagne
by William Neidinger

In the chapter room in the cloister of the Abbey of Valmagne is a lapidary collection, the stones of which have been amassed over the years from various places within the monastery itself and from the adjoining fields. Some of the stones are carved pieces of imported marble that appear to have no evident association with any structure of the extant monastic buildings; they could possibly belong to earlier structures not yet uncovered. The owners of the abbey believe that their lands rest atop an ancient Roman villa. Only excavation would be able to verify that assumption. Other stones come from parts of the monastery that have been damaged over the ages, but enough interesting features remain on the fragments to warrant their preservation.

Two of the stones are tombstones. The style of the script on both is similar, that of the thirteenth century. Both of the stones have been re-cut and re-used. The larger tombstone is so badly damaged from wear and re-cutting that just a few letters are legible along its perimeter but not enough to hazard any reconstruction of the original inscription.

The smaller tombstone, though damaged, has enough preserved that one can make a fair reconstruction of its original appearance. On one side is a cross-shaped indentation into which a metal cross was most certainly affixed. On the other side are seven lines of a funerary inscription in Latin. The top line is badly damaged and only about half of the letters are decipherable. And since the stone has been re-cut and re-used, it is not known how many lines are missing, although from the sense of the inscription it appears that few, if any, are. The inscription contains the usual thirteenth century abbreviations and, typically, all the letters are separated by three vertically arranged dots, resembling the chemist's triple bond symbol (⋮). A translation of the inscription reads:

> In the year 1233... when
> you enter the universal way of the flesh.
> You have been snatched from human things, Oh, Man!
> Why do you look at me?
> What I am, you will be. Sightless.
> Do not be astonished, because perhaps tomorrow you will die.
> He who reads this say
> an "Our Father" for my soul.

Along with the tombstones and miscellaneous carved marble architectural pieces, there are thirteen blocks of limestone with the remnants of carved figures in relief. These thirteen blocks all appear to have been originally part of some sort of chancel or choir screen, whether a screen of the earlier twelfth or the later thirteenth century church is uncertain. At an unknown later date (perhaps during the Religious Wars or the French Revolution) the screen was dismantled and the stones re-cut and put to another use.

All thirteen stones have been re-cut to a fairly uniform thickness of 16.5 - 18.0 centimeters. This re-cutting accounts for the flattened "unfinished" look of the figures, all the features in highest relief having been shaved off. In addition to having been cut to a uniform thickness, the blocks of the screen also have been cut into various polygonal shapes, at times slicing through a scene or even a figure. Whoever re-cut the stones obviously had no regard for the sanctity of the persons depicted; hence, the suspicion that the re-cutting may have taken place during a time of religious upheaval. All stones also have one side with a lipped molding, most of which show some remains of whitewash. That would seem to indicate that the edges of the stones with the lipped molding were the parts showing to view. And since the backs of the stones and the faces with the shaved-down figures show absolutely no sign of wear, whitewash or damage, it is reasonable to assume that these two sides were not exposed to view or usage. The owners of Valmagne believe that the blocks had at one time been incorporated into a stairway leading from the upper floor of the cloister into the interior of the church along the southern transept wall. There are, in fact, a few white limestone blocks, about 15-17 centimeters thick that are still imbedded in this wall. The exact arrangement of the stones in such a stairway remains, however, problematic.

The figured stones have been assigned, for the purpose of this article, numbers in the order they appear currently arranged in the chapter room, running left to right. Some of the scenes depicted are damaged beyond recognition, some can be identified only tentatively, and with others identification is quite certain.

#1. Scene unidentifiable.

#2. (See Figure 32) Two figures are facing towards the viewer's right and one is pointing in that direction. A crenellated building to the left is probably an artistic abbreviation for a walled city. The scene most probably represents the arrival of the Magi in the Holy Land, the city being either Bethlehem or Jerusalem.

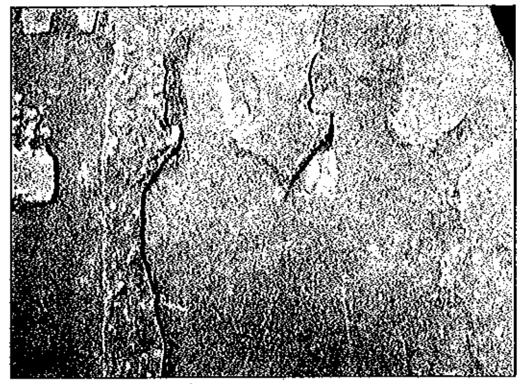


Figure 32.

#3. (See Figure 33) A winged figure to the right is greeted by three female (veiled) figures approaching from the left. They have their heads bowed and the leading figure has her hands clasped in prayer. This scene is undoubtedly the three Marys at the tomb talking with the angel. All the figures' lower halves are blocked by a large flat surface; this may be the artist's way of showing them standing behind the tomb.

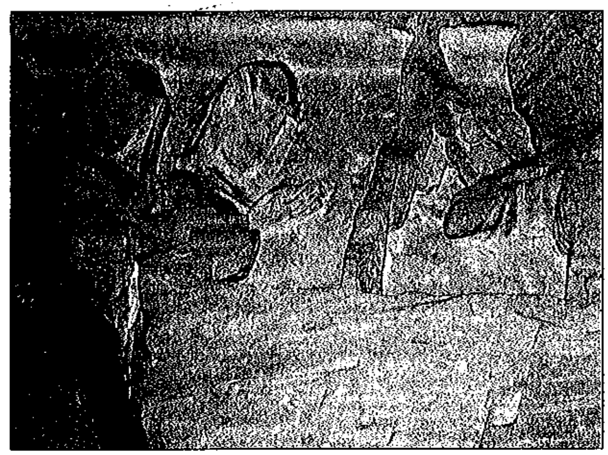


Figure 33.

#4. (See Figure 34) This scene is the Crucifixion. Two men on ladders nail Christ to the cross. The haloed figure to the right appears to be holding a sword, staff or lance; possibly this is Longinus. The figure to the right of him is damaged beyond recognition.

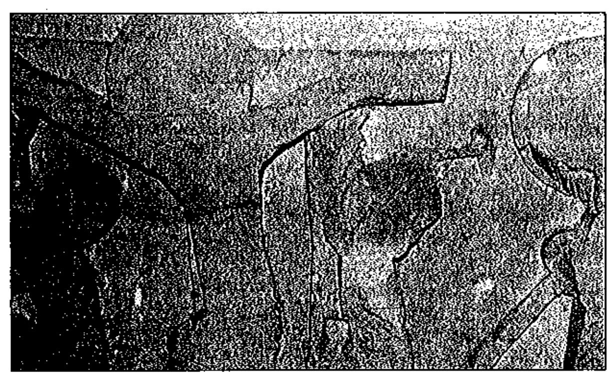


Figure 34.

#5. (See Figure 35) This scene is problematic. To the left we have a haloed figure wearing what looks like a bishop's miter. He stands before an altar with a crucifix and a crooked staff. With her back to this man and the altar is a veiled woman with her hands clasped in prayer and her head bowed slightly. She is facing three men with haloes, the closest holding a crooked staff. An unidentified object is seen between this man and the woman; this object seems to be coming down from above. Despite the cross on the altar and the bishop's miter, the figure to the left may be the High Priest of the Temple of

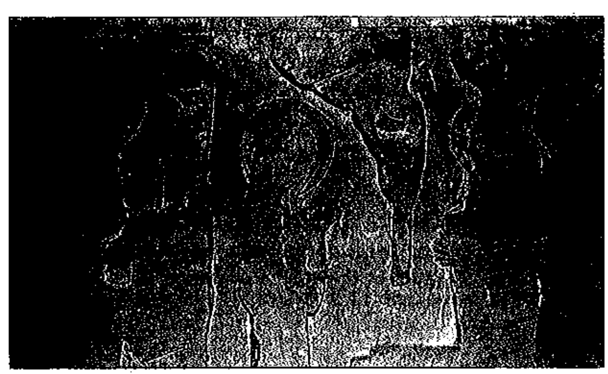


Figure 35.

Jerusalem (often depicted with Christian regalia in medieval art). The female is likely to be the Virgin Mary. The other figures make the scene difficult to interpret. Could it be Mary's presentation at the Temple, her betrothal to Joseph or even the presentation of Jesus at the Temple for his circumcision? But if the praying figure is a young Jesus and not the Virgin Mary, then the scene may be Jesus and the Elders at the Temple.

#6. (See Figure 36) The group of at least two figures which seem to be hovering in mid air is difficult to interpret. To their right is a haloed man on horseback, turning around, brandishing a cape; he appears to have a sword in one hand. The episode is St. Martin sharing his cloak with the beggar. If the figures to the left are part of the same scene, they may be either Jesus (as part of the Trinity) appearing to Martin in a dream and announcing that he was the beggar, or St. Martin being carried to heaven by the angels.

Figure 36.

#7. (See Figure 37) To the left are figures of the Deposition. But the two figures to the right have their backs to the cross and Christ and one seems to be pointing skyward. It would be wrong to think that these latter figures are attesting to Jesus' ascension into heaven because certainly the scenes of the Marys at the tomb and the Resurrection would intervene between the Deposition and the Ascension. Perhaps the pointing figure is the man in Mark 15:39 who says, "Surely, this man was the Son of God." But it seems odd that he would have his back to Christ.

Figure 37.

#8. (See Figure 38) This is another of the problematic interpretations. There is a haloed figure (male or female uncertain) facing a figure with its finger pointed heavenwards. They appear to be standing behind something similar to the tomb in #3. This might be part of the Three Marys scene in which the angel tells them that "He is risen" (Mark 16:6).

Figure 38.

#9. (See Figure 39) Another problematic scene.. To the left is what appears to be the mast of a boat. In the center is a (haloed?) figure (perhaps Jesus) and to the right is a person, one hand uplifted, on a decidedly lower level than the middle figure. An easy identification might be St. Peter and Jesus on the Sea of Galilee. But the only disturbing feature is the squarish item around Jesus' neck.

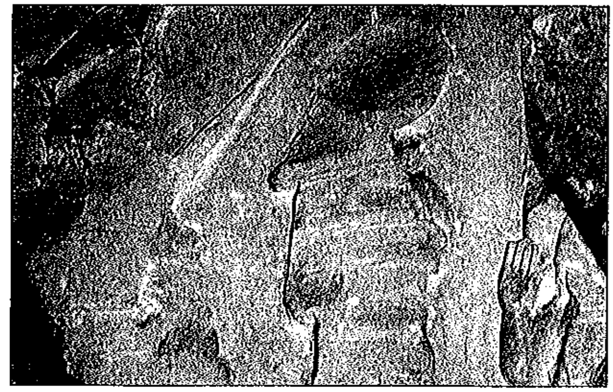


Figure 39.

#10. (See Figure 40) The episode depicted in #10 may well be a continuation of the scene in #2, that is, part of the arrival of the Magi. The leftmost figure is, again, crowned and with a crook. He faces a veiled woman holding a jar, possibly Mary receiving a gift from one of the Magi? The rightmost person seems to be departing from the scene, perhaps the departure of the Magi?

Figure 40.

#11. (See Figure 41) The three interlinked arms of the figures to the left are the usual depiction of the boys of the episode from the book of Daniel, "The Three Hebrews in the Furnace." The hand reaching towards the right figure must be the angel rescuing them from the flames of the furnace of Nebuchadnezzar, who may be the figure on the right leaving the failed executed in dejection. A hand protruding from the furnace wall may be the hand of the angel calling the king back to witness the miracle.

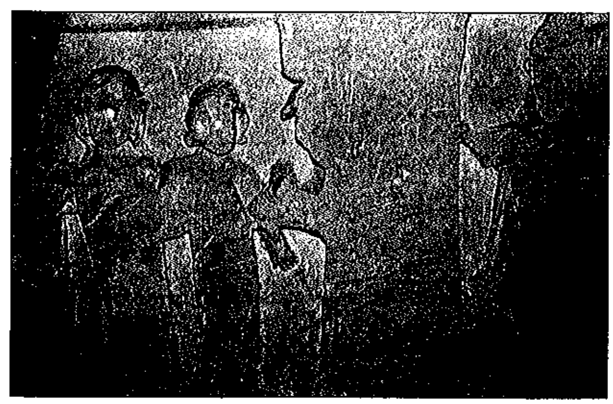


Figure 41.

#12. (See Figure 42) A haloed figure riding an animal towards a cheering crowd must assuredly be a representation of Christ's entrance into Jerusalem on Palm Sunday.

Figure 42

#13. (See Figure 43) Yet another problematic scene. A haloed figure with his arm upraised towards a slightly stiff individual. Jesus' resurrection of Lazarus? Possibly. But how to account for the capital-like structure "Jesus" seems to be perched upon. Might it be St. Simon Stylites (the column sitter) blessing one of the faithful? That would, however, be a rather rare scene in medieval French art.

It is almost impossible to reconstruct the original arrangement of the stones in the choir or chancel screen. Some of the scenes (Crucifixion and Deposition, for example) can obviously be connected in a chronological order. But where scenes of "St. Martin and the Beggar" or "The Three Hebrews in the Furnace" might fit is unclear. There are, additionally, the stones that are still imbedded in the south transept wall. Add to all of this uncertainty the facts that there may have been more than one screen and that the screen or screens may come from an earlier church rather than the extant one and one can appreciate the complexity of any hypothetical reconstruction.

Figure 43.

The Wine of Valmagne
by Gail Gant

Located in the Languedoc-Roussillon region of France, the Abbey of Valmagne rises impressively above the surrounding vineyards and wheat fields. Characterized by warm days, cool nights and little rain, the Languedoc area provides optimal growing conditions for a variety of grapes. The Cistercian monks began the tradition of making wine at Valmagne in the 12th century when the original church was founded. During several hundred years of wealth and expansion, the abbey grew and prospered, reaching its current Gothic proportions. Afterwards Valmagne was involved in several centuries of strife and warfare interspersed with periods of calm before succumbing to the political turmoil of the French Revolution. Falling into the hands of the state, the property was sold to Monsieur Granier Joyeuse who resuscitated the idle vineyards. Upon his death a half century later the abbey was purchased by the Count of Turenne whose descendants still retain the property and continue the wine-making tradition.

No longer used for religious purposes, the cool dark interior of the church provided an excellent set of conditions for the production of wine. In the 1820s, eighteen massive Russian Oak barrels, capable of holding between 8,000 and 45,000 liters, were installed in the side aisles, transept chapels and apse chapels (See Figure 17). Today, three of these barrels are still used to blend varietals that are later incorporated into the higher quality reds. The bulk of the grapes are now fermented in a nearby building constructed in the 1920s (See Figure 44). This structure, built into the side of a hill to ensure cool temperatures throughout the year, contains stone and concrete vats, which further insulate the fermenting grapes.

Figure 44. Philippe d'Allaines (left) leading a tour through the winery.

The threat of phylloxera, a type of louse accidentally brought to France from the United States, encouraged the establishment of *magnanerie*, areas where silkworms were grown, as an insurance against possible damage to their vineyards. At first, vineyard owners questioned the unrelenting havoc phylloxera was predicted to have on their fields. Once it struck, however, no remedy seemed to deter the deadly disease which ate away at the roots of the vines. Desperate to contain the damage, vineyard owners tried a variety of measures, including pouring boiling water on plant roots - all to no avail. By the time the phylloxera rampage had come to an end, 10,000 sq. km of French vineyards had been destroyed. The French wine industry survived the crisis when the American vineyards sent phylloxera-resistant root stocks that the older varietals were then grafted onto.

Between 1863 and 1870, it was quite common for wine makers to also maintain a *magnanerie* as insurance against the devastation that would occur should their vineyards be attacked by phylloxera. While the interior of the church was traditionally used for fermenting and blending wine, mulberry trees in the courtyard were used to feed silkworms. The silk threads produced at Valmagne were made into stockings, scarves and other articles of clothing in Ganges and Lyon. Silk production remained a profitable enterprise for the abbey during the latter part of the 19th century and the beginning of the 20th. The development of nylon after World War II, however, caused the remaining *magnaneries* to disappear. As the silk industry waned, the wine industry prospered and became the primary source of business for the abbey.

During the first part of the 19th century, the abbey wines were essentially sold locally. With the onset of the Industrial Revolution, however, a network of trains made it possible to send Valmagne wines farther away. This development opened up markets that had previously been difficult to reach. In the case of Valmagne and many other Languedocian wines there now existed a way to transport large quantities of inexpensive wine to northern France where the average coal miner was said to have consumed approximately 10 liters a day. As a result of these developments, Languedoc-Roussillon producers made as much wine as possible, paying little attention to quality. During the 1950s and 1960s, the mines began to close. Suddenly faced with decreasing demand for their product and feeling the effects of a decades long reputation for low quality wines, some Languedocian producers began to replant their vineyards, investing in merlot and cabernet sauvignon grapes in an effort to salvage their decreasing profit margins.

In order to ensure the high quality and fine reputation enjoyed by French wines, the first comprehensive wine legislation was passed in 1935, resulting in the development of a stringent set of government standards regulating how, where and under what conditions grapes are grown, fermented and bottled. Wines meeting these standards are designated as Appellation d'Origine Contrôlée or AOC wines, literally meaning that they come from a controlled place of origin. Wine-makers that meet these standards are considered to be the elite of the French wine industry. By 1985, certain Languedocian wines, including a percentage of those produced at the abbey, qualified as Appellation d'Origine Contrôlée wines. At Valmagne, the varietals grown on the steepest parts of the domain have been classified as AOC. Valmagne also makes several Vin de Pays or country wines. These wines are of reasonable quality and representative of the traditional varietals of the region.

The quality of a wine is affected by four variables - the type of grape(s) used, the climate, the soil, and the skill of the wine-maker. Approximately seven kilometers from the port city of Mèze, the vineyards of Valmagne are situated on clay and chalk slopes under an ideal set of climatic conditions (See Figure 2). The determination of where the various grapes varietals will be planted is decided by the composition of the soil. Mineral differences in the soil, the *terroir*, impart subtle nuances to the wine making it a primary consideration in the placement of the vines. At Valmagne, 12 hectares of ocher colored earth are set aside for the grapes used to blend Cuvée de Turenne, the abbey's most distinctive wine.

Prior to World War II, the vineyards occupied 100 hectares. Current laws, however, prevent the utilization of more than 80 hectares for this purpose and the remaining land is used to grow *ble clur*, a type of wheat used in the production of bread. Out of the 80 available hectares, nine are used to grow the white varietals and the rest for the reds. Although 50% of the area is devoted to the cultivation of grapes that will go into the AOC wines, these wines comprise only 35% of Valmagne's total production as they produce a lower yield.

The typical grapevine yields enough fruit to produce six to seven bottles of Vin de Pays wines per year. Grapes are harvested in September and October with a large combine (See Figure 45) that collects the fruit as it moves through the rows. The grapes are then set on conveyor belts

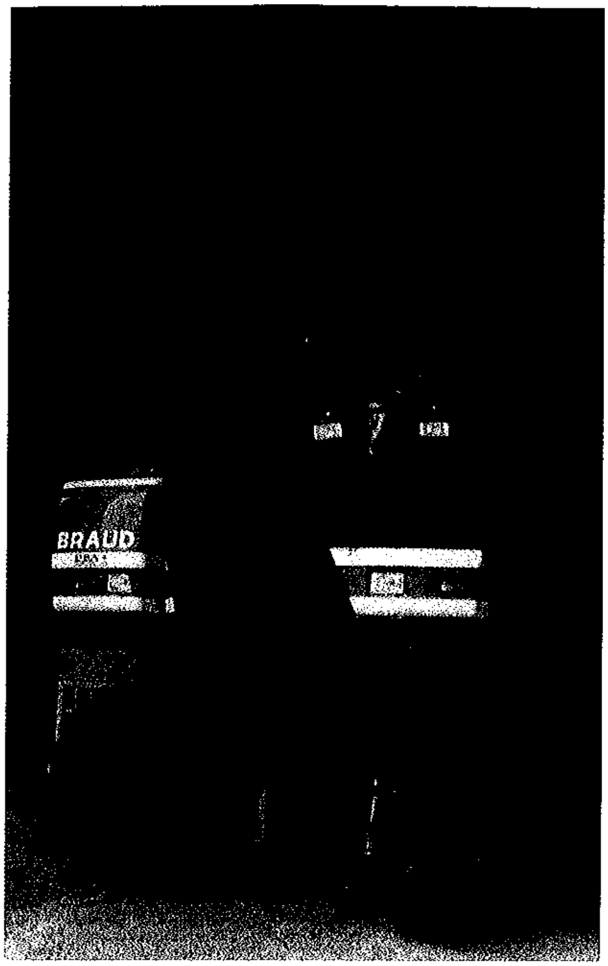


Figure 45. Combine.

that transport them to the eight concrete vats in which fermentation will take place. Each vat is equipped with a cooling system that precisely controls the temperature of fermentation.

White grape varietals must be carefully crushed in order to keep the skins from coloring the wine. Fermentation takes place between 16-18 degrees Celsius over a period of 8 to 15 days. The AOC Valmagne white, which is 70% Roussanne and Marsanne and 30% Grenache Blanc and Bourboulenc, is matured in stainless steel vats after the completion of the fermentation process. Bourboulenc and Marsanne grapes are also used in the white Vin de Pays along with Viognier and Muscat varietals.

The Vin de Pays Vin Gris, a type of rosé, is composed of Cinsault, while the AOC rosé combines Syrah with Cinsault. The lightly tinged color of these wines is achieved by allowing the crushed grapes to intermingle with the grape skins for a 24 hour period before separating the must from the liquid, which is then fermented in the same manner as the whites.

The Appellation d'Origine Contrôlée red wine is 50% Syrah, 35% Mourvedre and 15% Grenache. Each type of grape is vinified separately at temperatures of 28 to 30 degrees Celsius over a period of 10 to 30 days. In December the varietals are blended to produce wines possessing body and supple fruit. The Vin de Pays reds are blends of Grenache, Cinsault, Merlot and Cabernet Sauvignon. These varietals are fermented over a 5 to 8 day period.

In general, all of the Vin de Pays wines are ready to drink as soon as the fermentation process is completed. Appellation d'Origine Contrôlée wines are all involved in an aging process of several months to a year which takes place in oak barrels as well as in the bottle. All of the Abbey of Valmagne wines are blends except for their Cabernet Sauvignon. Once relying on outside sources for the bottling of the wine, the Abbey of Valmagne winery began to bottle its own product 28 years ago when it became clear that it was economically feasible to do so. All of the AOC wines are bottled in the spring. Today the wine production is overseen by Philippe d'Allaines, a seventh generation descendant of the Count de Turenne who purchased the abbey in 1838. Monsieur d'Allaines is assisted by Xaviere Porri in determining when the varietals are adequately fermented and blended. The winery requires five other employees to accomplish the field work and bottling. In the course of a year, the Abbey of Valmagne produces 250,000 bottles of wine, 3,000 bags in boxes, and the remainder of the Vin de Pays is sold in bulk.

Since the 1980s Valmagne wines have been exported to other countries such as England, Belgium, and the USA. In addition to increasing the number of exported wines, future plans include the introduction of a red varietal called Morrastel, similar to Graciano, a Spanish varietal used in Rioja wines. As the better known Bordeaux and Burgundies continue to soar in price along with Italian Tuscan and Piedmontese wines, the wines of the Languedoc-Roussillon region increasingly provide a pleasant alternative for wine drinkers in search of a bargain. This has not gone unnoticed by the esteemed wine connoisseur Robert Parker who listed Valmagne's Coteaux du Languedoc (AOC) white, and the 1995 and 1996 Coteaux du Languedoc Cuvée de Turenne reds among the top 300 wine bargains of the year in the June 26, 1998 issue of the Wine Advocate. If current trends at the Abbey of Valmagne continue, the more than 700 year-old wine-making tradition begun by the Cistercians shows no sign of coming to an end.

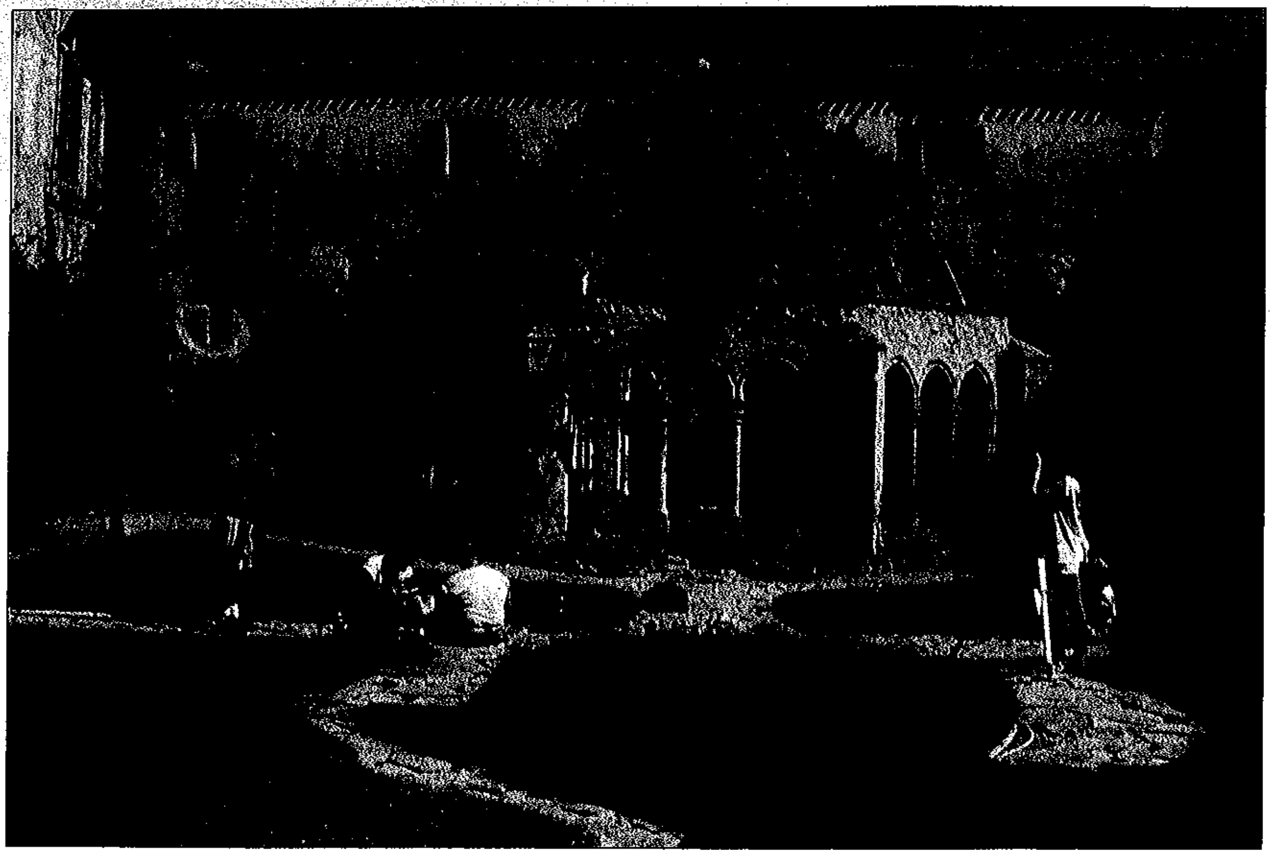


Figure 45. Survey work in the cloister garden at Valmagne.

CREDITS

A Brief History and Short Description of the Cistercian Abbey of Ste. Marie de Valmagne by Eulah Matthews and William Neidinger.

Photographs by Tanja Peterson. Acknowledgements to Mme d'Allaines, *Abbaye de Valmagne*.

The Buttressing of the Abbey Church of Valmagne by Vivian Paul and Robert Warden.

Photographs by Tanja Peterson.

Survey Methods by Gene Ryan and Robert Warden.

Photographs by Tanja Peterson.

Total Station Crews: Shahnaz Aly, Aimee Bond, Richard Burt, Lonnie Champagne, Nancy Cox, Debbie Moore, Rick Stauffer.
Photogrammetry Team: Richard Burt, Mark Peterson, Tanja Peterson, Walter Schroeder.
Hand Measuring and Survey Teams: Nancy Cox, Gail Gant, Harriett Isgren, Debbie Moore, Jerry O'Neil, Suraya Selim.
3D-Digitizer Teams: Shahnaz Aly, Richard Burt, Eulah Matthews, William Neidinger.
Excavating Team: Eulah Matthews, William Neidinger, Jerry O'Neil, Mark Peterson, Rick Stauffer.

The Stones of Valmagne by William Neidinger.

Photographs by Tanja Peterson.

The Wines of Valmagne by Gail Gant.

Interview with Philippe d'Allaines. Photographs by Tanja Peterson.

THE TEXAS FOUNDATION FOR ARCHAEOLOGICAL & HISTORICAL RESEARCH THANKS THE FOLLOWING PEOPLE FOR THEIR PARTICIPATION IN THE 1998 EXPEDITION TO VALMAGNE:

TEXAS A&M MEMBERS

Shahnaz Aly
Aimee Bond
Richard Burt
Nancy Cox
Debbie Moore
Vivian Paul
Robert Warden

TFAHR MEMBERS

Lonnie Champagne
Gail Gant
Harriett Isgren
Eulah Matthews
William Neidinger
Jerry O'Neil
Mark Peterson
Tanja Peterson
Gene Ryan
Suraya Selim
Walter Schroeder
Rick Stauffer