



2-1 Saint-Denis Abbey, ambulatory.

Chapter 2: Getting the Point--The Invention of the Gothic Spire

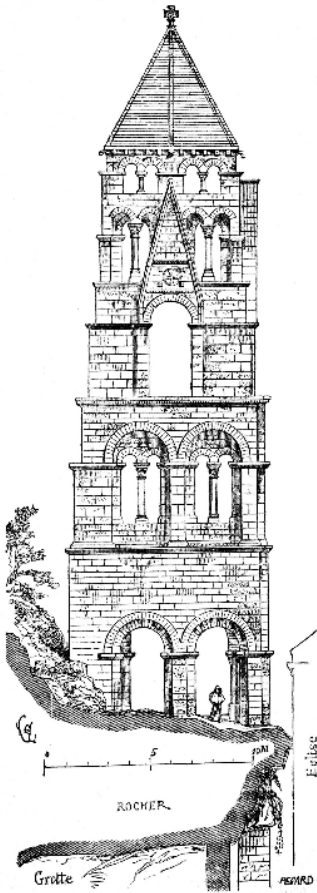
The invention of the great spire type in the mid-twelfth century in many respects paralleled the contemporary emergence of the Gothic style, but this provocative parallelism has attracted surprisingly little scholarly attention. Accounts of the early history of Gothic architecture tend to emphasize the importance of a relatively small set of monuments, most notably Suger's Saint-Denis Abbey, in which the consistent use of rib vaults together with the piercing of large windows and the attenuation of supporting structure led to a new and dynamic sense of interior space (fig. 2-1). In the words of art historian Paul Frankl, Gothic was "a style of becoming," in which the static, additive, blockiness typical of the Romanesque gave way to dynamism, diagonality, interconnectedness, and what he called partiality, the sense that the whole structure could be progressively subdivided into



2-2 Chartres Cathedral, south spire base, seen from above.

parts whose form would echo and harmonize with that of the whole.¹ These, however, are essentially the same formal principles that characterize the great spire type. The diagonal lines of the gables and pinnacles seen in even the earliest great spires, such as the south spire at Chartres (figs. I-1 and 2-2), create an impression of dynamic visual elision on the spire exterior, just as the diagonal vault ribs do in the Gothic church interior. The harmonic relationship between the pinnacle and spire forms, meanwhile, provides a perfect example of partiality. With their striving vertical lines and complex dynamic geometries, in fact, the earliest great spires embody the stereotypical qualities of Gothic design to a greater degree than most church vessels of the period. The construction of the first great spires in the middle of the twelfth century should therefore be seen, no less than Suger's contemporary reconstruction of the Saint-Denis choir, as heralding the birth of a new era in architecture. Indeed, the fact that similar formal principles arose independently in both spire design and interior articulation suggests that the emergence of the Gothic design sensibility was a widespread and robust historical phenomenon, not the

¹ Paul Frankl, *Gothic Architecture*, 10-14. If Frankl had lived to see the development of computer-aided mathematical research in the 1980s and 1990s, he would probably have been struck by the parallels between Gothic "partiality" and the "self-similarity" seen in the mathematical structures known as fractals, which incorporate a theoretically infinite amount of hierarchically organized detail.



2-3 Brantôme Abbey, belfry elevation (19th-c. drawing).

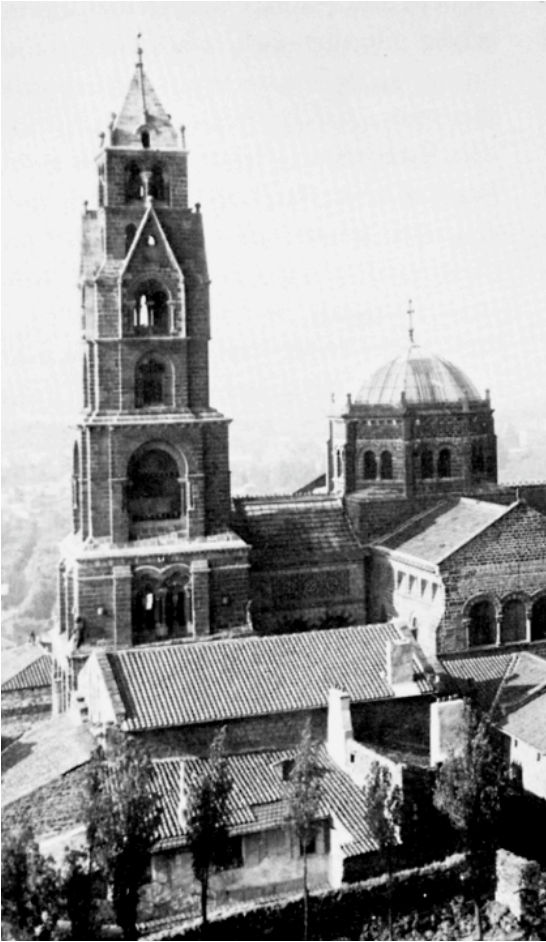
historical accident that it can sometimes seem to be when Suger's Saint-Denis is studied in isolation.

The emergence of the great spire type coincided chronologically with the advent of the Gothic style, but the roots of great spire design do not overlap geographically with those that have usually been associated with Gothic architecture as a whole. This disjunction helps to explain why the relationship between the two has never been carefully explored. The architectural ideas seen in Suger's Saint-Denis and other related monuments appear to have come largely from Normandy, Burgundy, and the indigenous traditions of the Ile-de-France. The most direct antecedents of the great spire type, meanwhile, occur in two related groups of central French belfry towers dating from the late eleventh and early twelfth centuries. The Auvergnat belfries of Brantôme and Le Puy differ from Limousin examples such as those of Collonges and Saint-Léonard-de-Noblat principally in having square-planned rather than octagonal terminations (figs. 2-3 through 2-5).²

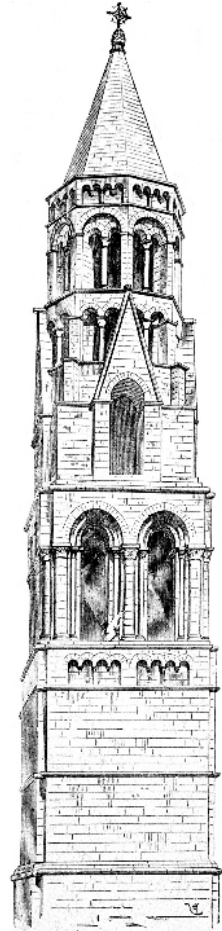
The commonalities between the two groups are, however, more significant. In all these monuments, diagonally sloping gables on the tower faces begin to break down the visual division between tower

stories, in much the same way that diagonal ribs break down the rigid divisions between bays of vaulting on church interiors. Because the use of the gable contributed to an effect of vertical elision, these belfries began to

² See Viollet-le-Duc, "Clocher," 3: 293-303; and René Fage, "Le Clocher limousin à l'époque romane," *Bulletin monumental* 71 (1907): 263-86.



2-4 Le Puy Cathedral.



2-5 Saint-Léonard-de-Noblat, belfry
(19th-c. drawing).

register as cohesive dynamic forms rather than simply as stacks of autonomous boxes.

The rationale for the use of the gable in this context appears to have been both aesthetic and structural. The belfries in question emerged from a tradition of tower construction in which the lower stories were considerably larger and more massive than the upper ones. This arrangement was well established, harking back to the period of Viking raiding when belfries

were built with defensible lower stories of stone and lightweight belfry superstructures of timber.³ It also made good structural sense, at least as long as the upper portions of the tower had to resist no large lateral forces. The use of stone rather than timber roof pyramids at Collonges and Brantôme in the late eleventh century, however, put new stresses on the upper belfry walls that the traditional lightweight structure could not easily sustain by itself. The gable reinforced this upper area unobtrusively by bringing massive masonry more characteristic of the lower story into the upper zone, disrupting neither the tower's overall tapering silhouette nor generally airier articulation of the upper stories.⁴ The basic designs of Collonges and Brantôme recur in their more svelte twelfth-century descendants, the belfries of Le Puy and Saint-Léonard-de-Noblat.

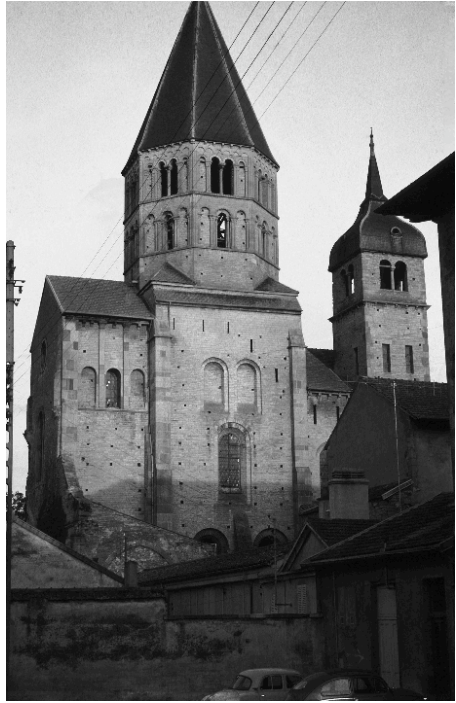
With their tapering proportions and sloping gables, these Auvergnat and Limousin belfries anticipate the great spires of the Gothic era. Those of the Limousin even include short octagonally planned stories immediately below their short terminal pyramids. These belfries, however, do not qualify as spires in the generally accepted sense of the word, since they lack the large and dramatic spire cones that would by the thirteenth century begin to transform the skylines of Europe. The decisive events associated with the invention of the great spire type appear to have taken place further to the north, in a belt running from Angers in the west to Auxerre in the East, with Chartres as its approximate center.

The first great spires worthy of the name were those of Chartres Cathedral, La Trinité in Vendôme, Notre-Dame in Étampes, and their considerably smaller cousin at Saint-Germain in Auxerre, all dating from the middle decades of the twelfth century. In these structures, the dynamic articulation style of the Limousin and Auvergnat belfry towers was combined for the first time with ambitiously-scaled stone pyramid terminations to form a new and impressive monument type that would enjoy popularity throughout the later Middle Ages. The relatively sudden emergence of the great spire type, coming as it did after centuries of slow experimentation in tower design, appears to have been the result of a fruitful synthesis of formal influences, catalyzed by the growing ambitions of designers and patrons in the region around Chartres.

³ For the links between these traditions, see, for example, Yves Delaporte, "Les Origines de notre clocher-vieux," *Société archéologique d'Eure et Loire mémoires* 17 (1937-42): 221-36. The continuity of belfry superstructure design is also noted in Forsyth, *St. Martin*, 217.

⁴ Fage, "Clocher limousin," 277.

The profound originality of the men who built the first great spires comes through clearly when one attempts to analyse their elegant creations in terms of the plausible influences on their design. The idea of the great spire amounted to much more than the sum of its parts. One factor in the impressive scale of the first great spires was certainly the new scale of the bells and belfries they contained, which were far larger than those popular in the eleventh century. This does not explain, however, the tremendous height of the grand but functionally superfluous spire cones themselves.⁵ Large pyramidal terminations had earlier appeared atop the octagonally planned crossing towers of Cluny and churches



2-6 Cluny Abbey, surviving transept tower.

in the Rhineland, but these were generally more squat in proportion than those of the Chartres spire group, and they had always been visually segregated from the vertical walls of the tower by a decisive horizontal crease (fig. 2-6). The question of how directly these eastern schools influenced the design of the first great spires remains open. The idea of using gables to mediate the transition between tower stories evidently came from the Auvergnat and Limousin belfry groups discussed above, but the analogous use of corner turrets to stabilize visually and structurally the space between the square-planned stories of the tower and its octagonal superstructure finds no obvious precedent in these monuments. Corner turrets had, however, been used in western French belltowers since the late eleventh century, and this tradition may have influenced the designers of

⁵ This point is made by Delaporte, who explains the origin of the spire in terms of a formal "principe d'élanement." ("Origines," 230).



2-7 Angers, Saint-Aubin, tower.

the first great spires.⁶ The corner turrets of the truncated twelfth-century tower of Saint-Aubin in Angers, in particular, offer close affinities with those of the Chartres group (fig. 2-7). The combination of these elements resulted in the creation of the great spire, a monument type that would continue to attract the interest of ambitious designers and patrons throughout the Gothic era.

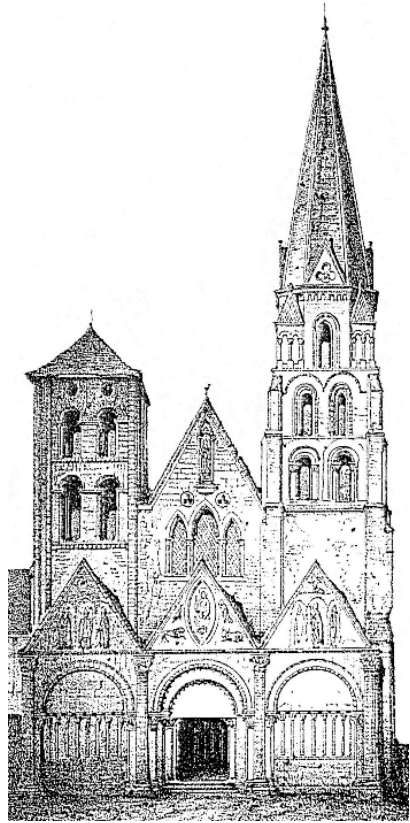
The spires of Chartres, Vendôme, Étampes, and Auxerre present variations on the same basic formal themes (figs. 2-8, 2-11, 2-12, and 2-13). In all these structures, an octagonally planned tower story mediates between several square-planned tower stories below and a large, slenderly proportioned stone spire cone. In each tower, the faces of the square-planned section are bifurcated, with a pair of

lancets at the upper level, while the octagonal portion has a single lancet on each cardinal face. This layout, seen also the Saint-Aubin tower and in many later great spire designs, creates a two-into-one window pattern emphasizing the changing geometry and tapering proportions of the tower as it begins to make way for the octagonal spire base. In all four towers, moreover, gables and corner turrets mediate the junction between tower and spire cone. There are, however, significant differences between the four monuments, both in their articulation and in their relationship to their host churches.

⁶ See Viollet-le-Duc, "Clocher," 3: 308-309, 320-22, and 365-69.



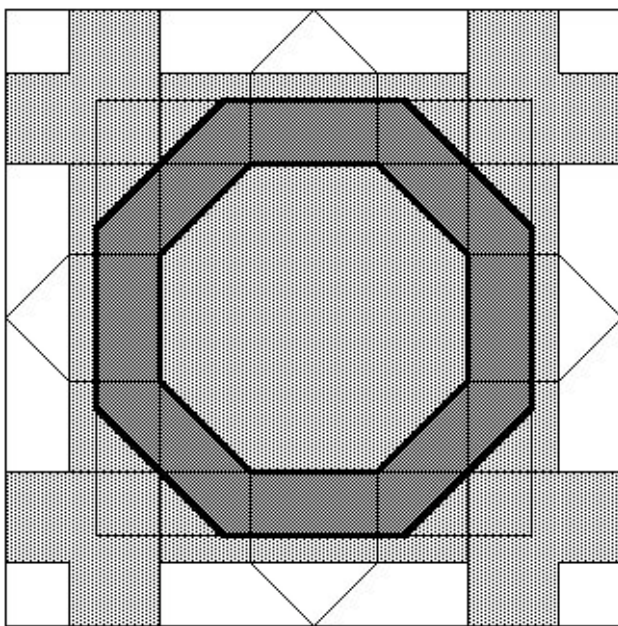
2-8 Auxerre, St-Germain, tower
(the so-called Tour St-Jean).



2-9 Auxerre, St-Germain, west
facade (19th-c. reconstruction).

The smallest and simplest spired tower of this first generation is that of Saint-Germain in Auxerre, known as the Tour St-Jean (fig. 2-8). With an overall height of fifty meters, it is just under half as tall as the south spire of Chartres. It differs from the spires of Chartres, Vendôme, and Étampes not only in its smaller scale, but also in its employment of round-headed arches exclusively. In this sense, the Tour St-Jean appears more closely tied to Romanesque tradition than the other three. In the absence of any authoritative documentation, it remains unclear whether this Auxerre spire was earlier than the others, or whether it simply reflected slightly more conservative taste.⁷ The forms of this spire, though, for all their apparent

⁷ The Saint-Germain spire has usually been dated to circa 1140 on stylistic grounds. See M. Claude Rolley in *L'Echo de Saint-Pierre d'Auxerre*, no 18 (November 1958): 15-17. More



2-10 Auxerre, idealized plan of St-Germain tower and spire.

simplicity, were both refined and elegant. The main spire cone is slightly convex, so that it emerges very smoothly from the tower below before tapering to its tip. The four small pinnacles at the corners of the main spire base echo this subtle swelling.

A number of other small spires were constructed in the Auxerre area in the middle decades of the twelfth century, but none of them had the smooth silhouette and formal sophistication of the Tour St-Jean spire, which would have appeared particularly revolutionary given its position as the southern pendant to a blocky eleventh-century tower at the western end of the abbey church of Saint-Germain (fig. 2-9). Since this older tower and the adjoining portions of the church were destroyed in the early nineteenth

recently, a date in the third quarter of the 12th century has been proposed; see Christian Sapin, ed., *Archéologie et architecture d'un site monastique: 10 ans de recherche à l'abbaye Saint-Germain d'Auxerre* (Auxerre, 2000), 116-17. For an older but more detailed discussion, see François Vachey, "Tour de Saint-Germain d'Auxerre," *Bulletin de la Société des sciences . . . de l'Yonne*, 1848, 275-309. Vachey's ground plan and elevation serve as the basis for the schematic figure 2-10, which presents a fully symmetrical ideal geometry for the tower. Sapin's detailed excavation plans agree with Vachey's tower plan.

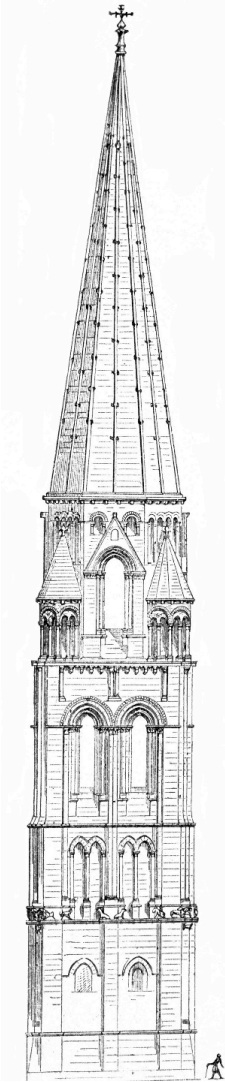
century, the spired Tour St-Jean stands alone today. Like most later great spires of the Gothic era, though, it should be understood in its original context as part of a church entry complex.⁸

The geometrical structure of the Saint-Germain spire anticipates that of later Gothic great spires to an almost uncanny extent. Indeed, the Saint-Germain spire presents one of the earliest and most lucid examples of a plan geometry that would recur in all its essentials not only in the thirteenth century, but in many spire projects of the Late Gothic era. The designer's fundamental geometrical tool was quadrature, the relationship between squares and the rotated squares inscribed within them, which together create octagons. In the Tour St-Jean, as in many of its successors, the fundamental module in the plan seems to have been a central square corresponding to the interior space at the tower's base. As figure 2-10 shows, the octagon inscribed around this square defines the outer surface of the spire's octagonal story, while the octagon inscribed within the square defines its inner surface. This operation thus yields the notional wall thickness of the octagonal story. By extending the sides of the outer octagon, the designer defined not only the location of the four corner tabernacles flanking the spire, but also the salience of the large tower buttresses at ground level. The details of the buttress and wall thicknesses were then determined, based on formal and structural considerations, within this basic geometrical armature. This quadrature-based design method, applied recursively to generate more complex forms, would suffice to determine the plans of most great spires for the next four hundred years. Thus, while the round-arched articulation of the Tour St-Jean remains residually Romanesque, its plan geometry and its soaring silhouette reflect the emergent Gothic taste for dynamic form.

Considerably larger than the spire of Saint-Germain in Auxerre, but roughly comparable in form, the great spire of La Trinité in Vendôme was probably the earliest of the great spires constructed in the area immediately around Chartres (fig. 2-11). The Vendôme spire and its supporting belfry tower, therefore, have usually been dated to roughly 1130, just before the start of work on the Chartres west complex. The tower stands free, like the earlier belfry towers of Brantôme and Saint-Léonard-de-Noblat.⁹ The

⁸ The demolitions took place in 1820. The drawing reproduced here as figure 2-9 was published in Jules Leclerc, "Abbaye de Saint-Germain," *Annuaire de l'Yonne*, 1841, as plate 1. Although published and perhaps even drawn after the demolitions, it presents a more detailed--and arguably more reliable--view of the facade than the cruder drawing made in 1652 and reproduced in Sapin, *Archéologie et architecture d'un site monastique*, 70.

⁹ See René Crozet, "Le Clocher de la Trinité de Vendôme," *Bulletin monumental* 119, no. 2 (1961): 139-48. Crozet distinguishes two campaigns of work in the interior belfry armature of the tower, but the tower and spire itself display great stylistic and structural homogeneity.



2-11 Vendôme, La Trinité, belfry tower (19th-c. drawing).

church of La Trinité was reconstructed in the Late Gothic era, but its location remained unchanged; the spatial relationship between the church and its belfry, therefore, still reflects the original intent of the twelfth-century builders. The structure of the Vendôme tower and spire displays several technical refinements. The walls of the spire cone grow thinner as they rise, which reduces weight in an area where the structure is already strong. A unique set of stone bracing arches supports the floor of the belfry story, perhaps meant, as Viollet-le-Duc believed, to damp vibrations from the swinging of the bells.¹⁰

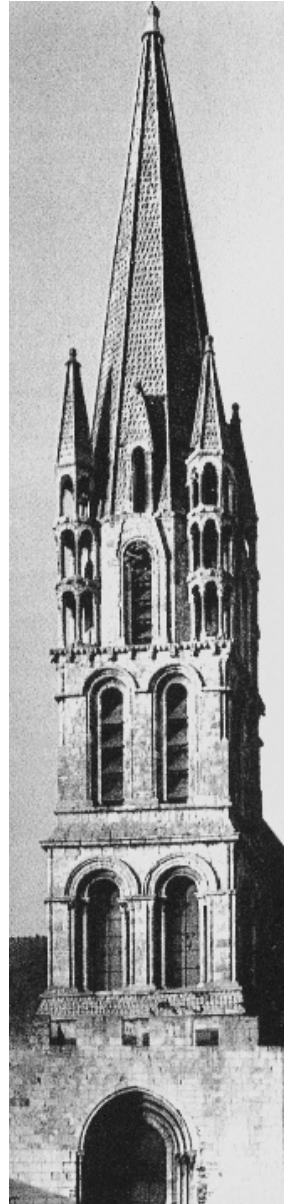
Like the spire of Saint-Germain in Auxerre, that of Vendôme presents a simple but elegant version of the early great spire format described above. At Vendôme, though, the sides of the spire are straight rather than convex, and the corner turrets are round in plan rather than square. These corner turrets are only one story high, with squat conical terminations that do not reach to the top of the octagonal tower story. The gables on the cardinal faces of this story, similarly, are fairly shallow in their pitch, so that they do not reach above the springing line of the spire cone itself. The overall silhouette of the structure is therefore very smooth and coherent, even though a prominent corbel belt punctuates the base of the spire cone. The faces of the spire cone are smooth, but narrow vertical strips run up both the centers of each face and the corner flanges between them, contributing to the sense of streamlining.

The great spired tower of Notre-Dame in Étampes has generally been less admired than its cousins at Vendôme and Chartres, in part because it does not present the same seamless structure from top to bottom (fig. 2-12). The upper tower stories and spire of Étampes were additions to an older tower

¹⁰ Viollet-le-Duc, "Clocher," 3: 355-58.

base positioned to the side of the church. Even within this added structure, there is a line of punctuation where the set of gables at the level of the tower octagon was truncated to make way for a second smaller set at the level of the spire cone. At Étampes, each turret consists of three arcuated drumlike stories, rather than just one at Vendôme. The upper drums reach above the spire base, so that the slender octagonally-planned corner pinnacles above them rise free. These pinnacles thus compete somewhat with the main spire that they resemble, rather than losing themselves in a single streamlined outline. These slender pinnacles deserve particular note because they must rank with those of the Chartres and Auxerre spires as some of the earliest pinnacles in the history of architecture. The surface of the Étampes spire is not smooth like that of Vendôme; instead, it is covered with patterns of stone scales. As petrified evocations of the slate tiles that covered humbler wooden roof structures, these scales remind the viewer that spires are, in principle, overgrown roof canopies. All of these features make the Étampes spire appear to be an elaborated version of its neighbor at Vendôme.

The south spire of Chartres cathedral may also be seen as an elaborated version of the Vendôme spire type, but its scale, formal refinement, and position within the material fabric of one of the most famous churches in France have earned it renown that few other church towers of any sort can match (figs. 1-1, 2-2, and 2-13). The overwhelming majority of scholarship dedicated to the Chartres facade, however, has concerned its stained glass and sculpture programs, rather than the architecture itself. Astonishingly, therefore, detailed archaeological investigation has only recently



2-12 Étampes, Notre-Dame, tower and spire.

begun to clarify the history of the Chartres west facade complex.¹¹

In general terms, it is clear that the incorporation of the south spire into a two-towered facade block reflects a change in the relationship between belfry towers and the churches they served at the dawn of the Gothic era. Precisely how the planning process for the facade block unfolded, though, has long remained controversial. A variety of factors suggest that the north tower, which now carries an elaborate sixteenth-century spire, was actually begun slightly earlier than its southern pendant. Its detailing is slightly simpler, and its southern face, which is now visible from the interior of the cathedral's nave, was articulated as an exterior surface. This curious fact, together with the presence of a window-like aperture in its eastern face, suggested that the north tower had originally been conceived as a free-standing belfry like the one at Vendôme. The south tower, by contrast, was clearly planned all along as part of a twin-towered facade block, since the articulation of its surfaces match their position in this ensemble.

In his recent analysis of the cathedral, Peter Kurmann has argued that the change of plans between the construction of the two towers was more subtle than many have supposed.¹² According to Kurmann, even the north tower was planned all along as part of a twin-towered facade block, begun after a fire in 1134 to provide a new and impressive entrance to the still-extant eleventh-century cathedral to which it was appended. At the beginning of work, apparently, a porch was planned between the towers, with the sculpted Royal Portal as its eastern wall. By the time the work on the south tower was undertaken, however, the porch idea had been abandoned, so that the Royal Portal could be installed in its present location aligned with the western face of the towers, giving the cathedral a substantially flat western terminal wall. The face of the southern tower immediately behind that wall was therefore articulated as an interior surface, unlike its slightly earlier northern counterpart. The history of the west complex at Chartres Cathedral, like that of Saint-Germain at Auxerre, thus documents a moment in the history of twelfth-century tower planning when the taste for independent belfries, as seen in Brantôme, Le Puy, and even Vendôme, began to be superceded. Virtually all great spires of the thirteenth century and beyond would stand as integral components of church entry blocks, rather than as parts of free-standing belfry towers. The substantial enlargement of Chartres Cathedral after another major fire in 1194 took this trend further than the designers of the south tower might have wished, since the later work encroaches on the tower all the way to

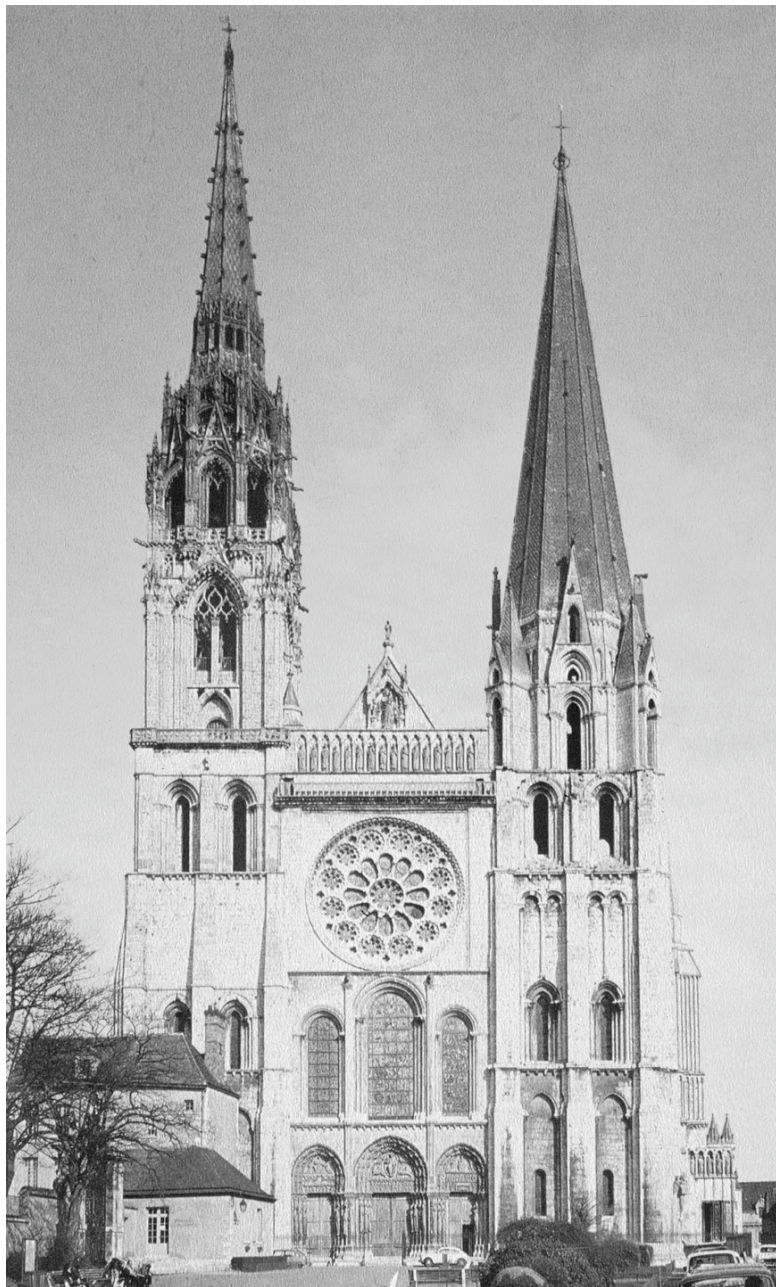
¹¹ Rüdiger Hoyer, *Notre-Dame de Chartres: Der Westkomplex* (Frankfurt-am-Main, 1991).

¹² Peter Kurmann and Brigitte Kurmann-Schwartz, *Chartres: La Cathédrale* (Paris, 2001), 36-52.

the spire base. Even so, the south spire manages to make a dramatic impression, holding its own against the slightly taller and far more elaborate spire added to the north tower in the sixteenth century (fig. 2-13).

The progress of the Chartres west facade project attests to the speed with which the great spire type developed in the middle decades of the twelfth century. When the north tower was begun in the 1130s, there seems to have been no thought of crowning it with a great stone spire. The principal tower buttresses terminate in the second story of the tower, roughly at the level of the present rose window centerpoint, rather than continuing up to provide support for heavy stories above. The double-windowed third story of the tower evidently reflects a slightly later phase in the evolution of the project. It appears rigidly foursquare in its outlines, but the diagonal placement of the tiny capitals on its corner colonnettes subtly suggests that a transition to an octagonal geometry was foreseen for the succeeding story. Unfortunately, the early history of the north tower cannot be authoritatively traced. Some kind of timber termination was probably planned, or perhaps even built, in the twelfth century, but no vestiges of such a structure have survived the interventions of the thirteenth, fourteenth, and sixteenth centuries, which are described in succeeding chapters. It seems clear, however, that there would have been a striking aesthetic and material disjunction between the blocky stone tower and the timber termination above. By the time the south spire was designed, probably by the middle of the century, this additive approach to design was becoming outmoded. The south tower and its stone spire appear to have been constructed in a single continuous campaign, having been conceived together as parts of a single structurally and formally coherent whole.

The beauty of the south spire derives largely from the smooth and subtle way in which the spire and tower forms blend together and interlock in the area around the spire base (figs. 2-2 and 2-13). As at Vendôme and Étampes, a combination of gables and corner pinnacles mediates this transition. The corner pinnacles of Chartres, however, consist of diagonally-planted aediculae rather than rounded turrets. These aediculae include not only tapering pyramidal terminations, but also small vertically-oriented gables. This complex angular arrangement of visually splintered surfaces allows the corner pinnacles to take up the vertical lines established by the corner buttresses lower on the tower, an effect often enhanced by the play of light. Within the strong visual frame created by these buttresses, the face of the tower undergoes a figure-ground shift in light and shade: in the uppermost square story of the tower, two dark lancets flank a brightly



2-13 Chartres Cathedral, west facade.

lit vertical buttress; in the octagonal tower story immediately above, two brightly lit vertical buttresses flank a single dark lancet. This elegant visual effect, which carries the vertical lines of the overall composition across a decisive geometrical shift, was rarely recaptured in later great spire designs, even when the arrangement of windows and buttresses was in principle the same, as at Cologne.

At Chartres, the diagonally and cardinally oriented faces of the octagonal tower story also relate with rare ease, creating a feeling of upwardly striving growth. The steeply roofed corner aediculae are pierced with slender lancets topped by smaller window openings, as are the gables of the cardinal faces. The two forms resemble each other closely enough to establish an approximate visual rhythm around all eight faces of the tower. At the same time, however, the slight differences between the two forms indicate that the transition to a purely octagonal geometry has not yet played itself out. The gables on the cardinal faces are tall and steeply pitched, reaching well beyond the base of the spire cone. The pyramidal roofs of the corner aediculae are somewhat lower, but they are also located further out from the central axis of the spire. The two sets of elements thus protrude from the main structure to approximately the same extent. Like the main spire, the sides of the gables and the roofs of the aediculae have scaled surfaces and decorative linear flanges. All of these features work together to blend the spire cone into the tower with enviable élan. The impression of surging growth that these features convey finds more explicit expression in the floral finials that crown each of the pinnacles and aediculae. These finials, among the earliest in the history of architecture, are the direct antecedents not only of the enormous finials, or Kreuzblume, seen atop many German Late Gothic spires, but also of crockets, which began to emerge as significant elements in Gothic architectural articulation in the decades around 1200. Column capitals of vaguely Corinthian form had of course preserved some idea of organic growth in earlier medieval architecture, but the design of the soaring and finial-bedecked Chartres spire gave this concept new aesthetic force.

The construction of the south tower and spire of Chartres was a triumph in technical as well as aesthetic terms. With an overall height of 103 meters, it remains one of the tallest spires in France, as well as one of the best-loved, having withstood more than eight centuries of weathering and two disastrous fires. The weight of the huge spire cone was reduced not only by the use of an unusually lightweight limestone, but also by the tapering of the spire walls from a thickness of 80cm at the base to 30cm at the summit, which required the cutting of complex block shapes with

subtly non-parallel faces. The impressive level of overall technical competence seen in the construction of the spire comes through also in certain subtle details of its design. It has been suggested, for example, that the stone scale pattern seen on the spire faces may have been intended to protect the masonry joints of the spire from erosion, since the scales shed rainwater away from the joint surface.¹³ The builders of the Chartres spire, together with their colleagues at Vendôme, Étampes, and Auxerre, demonstrated that slender and ambitiously scaled stone pyramids of octagonal cross section could be married to large square-planned towers with visual and structural success. The result of this marriage was an essentially new monument type, the great spire.

The emergence of the great spire type in the middle decades of the twelfth century paralleled the emergence of identifiably Gothic church vessels in the same years. Just as the vault rib opened the way to a new dynamism in the treatment of interior space, so too the gable and corner pinnacle permitted a new visual dynamism in tower and spire design. The formal principles of diagonality, partiality, and interconnectedness that Frankl identified as characteristic of Gothic design were thus present in the great south spire of Chartres no less than in the choir of Suger's Saint-Denis. This striking but little remarked-upon parallelism of formal conception suggests that the advent of the Gothic style was a more broadly-based phenomenon than most previous scholarship has implied.

The invention of the great spire type profoundly affected the subsequent history of architecture. The early great spire projects of twelfth-century France introduced the tall slender spire cone, effectively inaugurating the history of church spires in the form that would remain popular throughout the later Middle Ages and down to the present day. The invention of the spire form, moreover, provided a new motif for use in microarchitectural tabernacles and canopies, dramatically advancing the long-standing formal and symbolic dialog between church architecture and shrine design. The invention of the spire, in fact, resulted in the invention of the pinnacle, one of the most pervasive motifs in the entire repertoire of Gothic architectural design. Spirelike pinnacles animate the silhouettes of countless Gothic

¹³ See Jean Villette, "Le Clocher vieux de Chartres: La Flèche irréprochable," *Notre-Dame de Chartres* 48 (1981): 7-10. Villette suggests that the differences between the widths of the eight spire facets, and the irregular pattern of facet tapering seen in the very tip of the spire, represent the translation into stone of carpenter's techniques meant to stiffen the spire structure against wind loads. This may be an overly charitable analysis, since simple errors of alignment in the highly demanding spire construction process can also explain these irregularities, but the technical expertise of the Chartres spire builders remains impressive even in the latter scenario.

buildings, even those that do not have full-scale spires. These appropriations of the spire motif, important as they were, did not amount to an immediate embrace of the great spire type in all its complexity. As the following chapters explain, it was only in the later Middle Ages that an impressive tradition of great spire construction emerged as a worthy sequel to the pioneering achievements of the Chartres group.