including the muqarnas, which combine to create an architecture of illusion and ambiguity. In this connection one might add the observation that frequently in the cloister of the Court of the Lions, particularly in the pavilions that project from its short sides, the spandrels of the arches are composed of pierced grills of stucco. In other words, just where structure would appear to demand solids there are voids. As Grabar acknowledges, there is much we do not know about the structure of this part of the palace. One would like very much to know how the columns really support the cornices and roofs above them.

In summary, this is a very informative and thought-provoking book whose most useful function is to suggest new areas of research and to inform us of how little we really know about one of the greatest monuments to survive from the Islamic Middle Ages.

**JOHN D. HOAG**

University of Colorado

John James, *Chartres, les constructeurs*, Chartres: Société Archéologique d'Eure-et-Loir, 1977, part one, 104 pp., illus., diagrs., plans, sections. Table. 150Fr.

Because James's methodology has stimulated considerable discussion, two reviews are printed here: the first by an engineer, the second by an architectural historian.

**BOOK REVIEW EDITOR**

In a review paper published in this journal in 1971, Robert Branner commented that, "James's analysis of Chartres is likely to be the best and most detailed we shall ever have, if his book fulfills his predictions." Indeed, the illustrations on the front and back covers of this first volume of *Chartres, les constructeurs* suggest forthcoming riches: detailed isometric drawings of the cathedral in different stages of construction. Still, the reader must await these in future volumes; only the first five chapters of the projected 22 are to be found in the *Première partie*, and an index is sorely missed.

James's challenge to the prevailing view of the role of the master mason designer of Gothic buildings is contained in the opening lines:

The Cathedral of Chartres was not designed by three architects, or even five or six; in our sense of the word there were no architects at all—only building contractors who were led by men deeply trained in all the subtle aspects of their craft. The evidence shows that this cathedral was built by large mobile teams of masons who moved around the countryside from job to job working for as long as the money lasted. When the funds ran out they would leave the site in a body, the crews still intact under their master, to find another project.

This "evidence" is derived from perhaps the most exhaustive study of the entire fabric of a major historic building ever undertaken. James tells us that he could not limit his investigation to only a few regions; every stone had to be examined. Some insight into the care that he has taken for his study can be gleaned from listed dimensional tolerances for measurements—on details within elements: ± 0.1 mm (.08 in.); on whole elements, entire columns, bay centers: ± 20 mm (.8 in.); on larger dimensions of the whole building: ± 20 mm to a maximum of ± 50 mm (2 in.); and on verticals: ± 30 mm (1.2 in.).

Once each building program was isolated within its construction joints and James was able to study the individual details, he realized that not only did the joints separate different periods of work, but different contractors as well. "Geometry proved to be the ultimate tool. . . . A master would follow one set of rules in all his work: so any marked change in the shape of a detail reflected a change in the rules, and hence a change in masters." From the first foundation to the top of the transept rose, over 40 building campaigns were counted; and the mobility of the contractors was verified by his making similar observations of the work of many of the same crews beyond Chartres, from Tours to Reims.

James's dating of the building campaigns could serve to overturn a number of shibboleths about the construction of Chartres. In these first chapters he discusses in some detail the dating of the porches and their sculpture; but perhaps most important are his observations of the similarity of construction details of the upper portions of the nave and choir and his conclusion that both were constructed simultaneously. If the evidence is as clear as he indicates, it would controvert the generally accepted idea that the choir and nave were constructed at different times, and the continuous, "east-west" argument concerning whether the choir or the nave was the first to be constructed may finally be laid to rest.

In the course of reconstructing the assembly sequence, James takes into account the structural requirements of building elements as they are set into place as is illustrated, for example, by his showing the erection of a contiguous structure that acts as lateral bracing for the subsequent construction of a vault requiring abutment. This is a welcome addition to the usual approach to this complex subject; however, I am less sanguine about the presentation of many structural details given in the footnotes. These notes are often obscure. A statement such as "the strength of an iron girder varies with the cross-section of its members, and each cross-section varies as the square of its length, so it must follow that if we build two bridges geometrically similar, the larger is the weaker of the two," is an insufficient explanation of the problems involved in scaling up structural elements to larger buildings. One must also know that the volume and hence, the dead weight of the larger bridge, increases with the cube of its length; and in any event, it should be noted that, unlike an iron girder, the strength of masonry in compression rarely governs design reliability. Rather, it is overall stability (against overturning), or the absence or presence of tension within the mortar, that usually determines whether or not a masonry building is sound. Other problems arise when James attempts to explain how the master mason "used vectors" to design buttresses. He illustrates a number of examples of geometric constructions that seem to result in observed buttress orientations. Nevertheless, a vector quantity is characterized by magnitude as well as direction, and since the magnitudes of the vault thrust are unknown, his "vector" constructions must be arbitrary. These constructions are not unlike geometric proportional systems used to encompass façade configurations. This is clever reasoning, but not entirely convincing.

With its rich treatment of new material extending well beyond the cathedral itself, *Chartres, les constructeurs* is destined to become an influential work for architectural historians as well as historians of medieval technology. It is precisely for this reason that occasional lapses that seem to be related to a low level of interaction with workers in both of these fields are particularly regrettable. Although there is general commendation for this new perspective on Gothic construction from an "outsider" (James was trained and worked as an architect in Australia prior to this effort), dubious statements such as one stating that the chisel was first introduced in the middle of the 12th century should not be accepted readily by the reader. Reference is made also to rules of design "which were used in the design of all medieval buildings." Although I concur with John Harvey's observation, as quoted by James, that some type of structural rules were in use in the 11th century, my own observations of the proportions of certain structural elements from the early 11th century (such as the ratio of height to breadth of the main arcade piers) led

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James’s observations and measurements of the building fabric and the wealth of drawings, which we hope will soon appear.

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Researchers interested in the design formulæ used by the builders of Gothic cathedrals have tended to concentrate upon written sources (mostly late Gothic) and graphic evidence (plans, engravings, and so forth). This demands the application of a scrupulously careful methodology, as well as appropriate training and skills in surveying and craftsmanship. Difficulties are presented because any hypothetical “ideal plan” conceived by the initial master-designer might be subject to modification or misinterpretation in its translation into stone, and as the researcher measures in drafting a large-scale plan further errors can accumulate that result in a final measured drawing unlike the idea of the original designer.

Finally, the rediscovery of the “ideal plan” is subjective since it presupposes that the researcher is familiar with all of the procedures of his medieval predecessor.

Architect James undertakes the task of surveying and studying Chartres Cathedral for the purpose of producing plans, sections, projections, and an understanding of the sequence of construction. The author defines a formidable “code of ethics” to govern his work—an error margin of only two millimeters in building details—and a formal procedure designed to elicit the “ideal plan” from the forms of the building. James’s book, the first of a multivolume study, involves a process of extrapolation, or deduction, which proceeding from the study of the building is intended to give an understanding of the contribution of the several thousand people involved in its construction.

James begins with his conclusions regarding the constructors of Chartres Cathedral; however, it makes more sense to begin with a review of the archaeological methods employed. The author goes beyond a purely stylistic study to an analysis of the geometric compositions that he sees as a key for an understanding of the artistic personalities of the constructors. Even though the building has some superficial uniformity of style, James concentrates on certain zones, to some extent hidden from the casual visitor, that he feels reveal the changing approach to design and construction indicating the identity of successive groups of masons, such in the unlit area under the aisle roof, the interior of the staircase turrets of the transepts, and the transept piers.

In the area under the aisle roof, James describes three different types of corbel design in the small doors in the dividing walls of the roof space and in the rear well of the triforium. Since the corbels are similar in both the nave (north aisle) and in the choir, James argues that the nave and choir were under construction at the same time. James dismisses the possibility that one set of corbels might resemble the other through copying by pointing to the changes of stone type and cutting technique, which suggest the work of successive groups of masons (five groups) working in this area.

It would obviously be advantageous to bring the unfinished cathedral up to a uniform height prior to the installation of a provisional roof. By arguing in favor of horizontal campaigns of construction rather than vertical ones (from floor to vault, one bay at a time), James is subscribing to a theory concerning medieval construction practice that has found an increasing number of advocates in recent years: Salet for Cluny III, Branner for Reims Cathedral, Brandenburg for the Amiens Cathedral nave. Jan van der Meulan, as early as the mid-sixties, dismissed the futile argument concerning the priority of the nave or the choir at Chartres, showing that work began in the area of the crossing and continued in horizontal campaigns in both directions.

When considering whether the projecting porches were added to the transept façades (as certain scholars, including Louis Grodecki have suggested) or whether they form part of the original structure, James’s general conclusions conform to archaeological evidence and current scholarly opinion (van der Meulan, 1965; 1967). The argument for the contemporaneity of the south transept porch with the façade is based upon three lines of observation: there are no ruptures or poorly fitting joints at the points where the massive lintels of the porch meet the buttresses of the façade; the staircases inside the buttresses and the small doorways that open onto the porch roof are perfectly regular angular, showing no sign of modifications made to accommodate the porch; and the small gallery of statues over the porch is also regular in its construction, the innermost statue being coursed into the masonry of the buttress.

The north porch, James admits, is more complex, having taken some 22 years to construct. No explanation is offered for the abrupt termination of the small blind arcade that decorates the flank of the buttress of the north transept façade above the level of the porch roof.

If James is on safe ground with his conclusions concerning the contemporaneity of the transept porches with the façades, this is not the case when the argument is widened to include the sculpture. However much architectural historians might like to believe it, it is rarely possible to date sculpture solely by reference to the architectural chronology. Sculptural elements might be spolia (pieces saved from an earlier project), or they might be chiseled after the completion of the architectural frame, either in situ or as detached column figures that were later fitted into place. Ulti-

mately, our chronology for the sculptural programs of the Chartres transept façades must still be based on criteria relating solely to the evolution of sculptural style. James states that he will show that the masons and the sculptors were, in fact, the same men, but this demonstration is reserved for a subsequent volume.

He concludes with a formidable display of Morellian reasoning: the 49 sculptured stones forming the plinths of the piers of the north porch are attributed to five different crews of sculptor-masons.

When discussing the interior of the staircase turrets of the transept façades, James identifies and documents the geometric schema employed to determine the splay of the embrasures of the staircase windows. His presentation of the variety is masterful, but his conclusions demand that the reader accept the “one form, one man” belief—that every change in design implies a change in personnel. In introducing the reader to the kinds of foot units that he finds used in this part of the building, James should have provided references to the considerable body of published literature that deals with relating known types of medieval foot measurement with actual buildings. The reader is given no conclusions that would indicate exactly how many campaigns are postulated for the construction of transept façades, or how this work relates to the identification of the same teams of masons at work elsewhere in the building.

Having produced a large-scale drawing of the part of the building to be studied, James has reconstructed the hypothetical design procedure to document the artistic personality of the master mason-designer. The original drawings are unfortunately inaccessible to the reader, who has to content himself with small-scale sketch-plans with no indication of scale. Some of the design formulas are accompanied by step-by-step “how to do it” explanations; others are given in terms of small plans showing geometric and arithmetic relationships and proportions. The patient reader will learn much from James’s techniques and vision. His plans enable him to relate the proportions of the attached pier to the outside buttress and the dimensions of the mass of the pier base to the overall size of the bay. His discussion of the bay as something that can work, not just in terms of its dimensions from pier axis to axis or axis to wall surface, but as a concept that can also involve fictitious lines of axis within the mass of the wall is enlightening. The breakdown of the transept porch plan in terms of multiples of a modular unit, as well as proportions based upon construction and other procedures is of value, as is the demonstration relating to the proportions of the nave bays, since this reveals the thinking of the original constructors of the cathedral. Here James isolates a 1:2.4:2.1 ratio running transversely and a 2:1:7 proportion for the rectangle of the bay of the central vessel. It should be noted that the error margins in the transverse ratio defined are well over James’s own maximum error margin described in his “code of ethics” (errors of 50 to 77 centimeters occur; a mistake in subtraction leads James to reduce one margin from 50 to 13 centimeters).

It is regrettable that James’s simplified small-scale sketches do not allow the reader to play his own geometric games with the material; he is, instead, required to accept the author’s conclusions as the only possible interpretation. Since most of the geometric procedures used by medieval designers were related (root two-manipulated polygons, and so forth), it is sometimes hard to agree on the distinct character of the “geometries” ascribed to the different masters. The sceptical reader, although ready to accept the fact that certain design procedures were used in medieval architecture, will wonder why the master-designer shackled himself with the ball-and-chain of geometry to the extent postulated by James. Those individuals who have wrestled with the irregularities of a Gothic cathedral and the tantalizing vision of “ideal schemes,” may feel slightly resentful of James’s success in isolating so many design formulas.

The reader is told not to expect to find great architects responsible for the construction of Chartres Cathedral, but only teams of itinerant masters, like circus troupes. James admits that he has been forced reluctantly to accept the “enormous and alarming” fact that the construction of the cathedral involved more than 40 separate campaigns, each undertaken by a team of some 300 men, including masons and ancillary workers employed at the cathedral for the span of about one year. A team might return for a further spell of work; thus, only nine different teams actually worked at Chartres. After this employment, the core of the team, comprising about 100 men, would move as a group and work elsewhere; James finds evidence of the work of these masons at Soissons, Reims, Lagny, Laon, Braisne, Essomes, and Orbaïs. Three main factors account for this. Firstly, funds were available for short terms only, allowing for limited periods of construction. Secondly, since medieval mortar is said to be slow drying, no more than a few courses of stone could be laid at a time to ensure that the accumulated weight of masonry and the lateral thrusts of the arches and vaults would not damage the unsolidified lower walls. Finally, James argues that the annual routine of agrarian duties would take the laborers out of the workshop for some time each year. This situation, whereby teams of masons worked for a limited time before moving on elsewhere prevailed until the first half of the 13th century; after that the profession of the resident architect developed. Chartres was, thus, one of the last great monuments to be constructed by successive crews of contractors. To understand the character of each of these crews is to understand the design vocabulary of the master of that crew.

James’s reluctance to accept the fact that Chartres Cathedral was the result of some 40 campaigns of construction reflects his awareness that this interpretation is controversial, and only a matter of semantics. The work “campaign” has generally signified a unified, unbroken phase of construction conducted without a major change of plan. Thus, the construction of Bourges Cathedral involved two campaigns (ca. 1195 to ca. 1214; ca. 1220 to ca. 1260). James, however, uses “campaign” to signify a year’s work; few will disagree that the construction of Chartres Cathedral (the high Gothic parts) required some 30 or 40 years. The question of the role of the master mason or architect in determining the nature of the campaign is one of historical interpretation. The staggering variety of forms presented by James would lead one to suppose that no single master mason imposed an all-encompassing system of design upon the “hidden” parts of the building. This must remain a supposition; certainly it is not supported by the written evidence on Gothic architecture, but as James points out, this late evidence should not be applied to a 13th-century situation. However, several written sources of the 12th and 13th centuries contradict the claim that the installation of a permanent master mason was delayed until the mid-13th century. At Canterbury, the roles of William of Sens and William the Englishman are well documented. The named master masons of Reims and Amiens Cathedrals also merit discussion in this context. The hypothesis supporting large itinerant teams of masons is inherently implausible, and each of the three historical factors adduced by James is open to question. The speed of construction at Chartres indicates that the supply of funds was regular, copious, and continuing. Secondly, recent studies have suggested that the drying time and shrinkage of medieval mortar constituted much less of a problem than earlier writers had suggested (M. Wolfe and R. Mark, “The Collapse of the Vaults of Beauvais Cathedral,” Speculum, 11, 1976, 462–476). The fabric evidence from Troyes Cathedral shows that each bay of the 15th-century vaults of the nave took less than three months to center, construct, and decorate. The problem of lateral thrust bearing upon unconsolidated masonry was regularly met through the use of iron or wooden ties and provisional buttresses of various kinds. Chartres was a large urban center, which would surely have had a pool of labor available for the construction of houses, defense systems, and churches; and it seems unlikely that professional masons would have been involved in harvesting work.

The 14th-century evidence from Troyes Cathedral (accounts and contracts) suggests that terms of employment were an affair between the bishop and chapter and the artisan; no masons’ guild or any other such organization existed. James’s theory for Chartres pre-
supposes the existence of some authority among the masons powerful enough to induce the individual (who may have had family commitments) to leave the prospect of another year’s work in a building site where funds were ample to seek uncertain work elsewhere. Moreover, how could the organizers of the fabric be sure of the arrival of another qualified team to continue the work? James describes the master of the crew of masons as a “feudal chieftain.” Having commented that the conclusions relating to the organization of the construction of Chartres Cathedral could provide valuable insights into 13th-century society, James does little to defend or define this concept of authority over the masons, who, among the corps de métier in France seem to have enjoyed the greatest degree of freedom.

Perhaps if the numbers of the “crews” were reduced some, the theory might be more workable. A tightly knit group of half a dozen or so elite masons and their apprentices might, conceivably, have moved fairly freely, and could have had a great impact upon the buildings where they worked. But James is talking about a crew of some hundred artisans. This would enforce the credibility of the argument over the decorated plinth stones of the north transept porch, which might be the work of individuals, rather than “crews.”

To demonstrate the presence of successive teams, and their occasional return, James might have presented the reader with a careful analysis of the work of the “Scarlet” group or some other in two or more different parts of the building. He suggests that a group might evolve its design procedures over a period of years; it would obviously be very difficult to control the extent to which two different corbel designs might result from evolution within the group, or from two different teams. Eight groups of corbel profiles are presented in the French edition (missing in the English version), each one involving variations on a theme. It is noted that several of the profiles could easily be transferred from one group to another. A careful presentation of the work of one of the Chartres teams in another building mentioned by James (Orbais, Essomes, and so forth) would also have provided valuable documentation of the peripatetic framework of the 11th-century mason’s life, as postulated by James. Without this kind of demonstration, the possibility is left in the reader’s mind that a mason of that time might learn (as an apprentice) the habit of thinking in terms of a variety of potential solutions to any given design problem, and that in a two or two-year span, he might be inclined to apply more than one of them. Similar forms might appear in a neighboring workshop where masons had been trained in the same tradition.

While most rewarding in some respects, this book is also frustrating. The binding of the French edition disintegrated as the pages were turned. The English language version, while solidly bound, was characterized by an apparent heavy inking of the type; the lines of some of the illustrations bleed into the surrounding area. There are missing and transposed paragraphs and misspellings (especially French terms, such as “pilier cantonne”). The English language edition lacks the photographs of the French version, but unfortunately, the photographs do not add much, tending to be poetic, rather than objective documentation.

The reader will find no general introduction to the monument—its historical background, plan, elevation, or significance in the history of architecture. The discussion of the historical framework is relegated to a single footnote, and texts of prime importance (for example, the poem of William the Breton) are treated summarily. We are asked to study the cathedral not to understand it as a supreme piece of architecture, nor as an expression of the personality of the master mason, with his sublime vision and gifts of stereoscopic speculation, but rather as the work of the contractors or constructors who translated the ideas into stone.

The tone of the book is at times poetic, chatty, or heavily didactic; the reader is reminded of the exhortations of Villard de Honnecourt. A troubling question relates to the character of the anticipated audience. The layperson will be lost in the pages of geometric explanations, while the specialist might have hoped for a more fully documented presentation. A theme of prime importance for James is the presentation of the building as a kind of object lesson: “If we can come to see their work without the prejudice of our times, and can accept that even one building can repay a life’s love, we may find the inspiration to enrich the architecture of our own times.”

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During the past two decades, publication on major monuments of medieval stained glass has taken two forms. A series of carefully prepared catalogs consisting primarily of documentation have appeared under the auspices of the international Corpus vitrearum mediæ ævi. Other works have attempted to place individual monuments within their art historical context. Madeline Caviness’s recent investigation of the early glazing of the Cathedral of Canterbury has been followed by Meredith Lillich’s penetrating study of the windows of the abbey church of Saint-Père at Chartres, the neglected neighbor of the Cathedral. The appearance of two such monographs in two years represents a significant advancement in an area of study that in Lillich’s words is “barely emerging from a long infancy,” and should be of interest not only to historians of stained glass but of medieval architecture as well. Since Suger’s Saint-Denis, Gothic architects and glaziers had worked side by side. The collaboration occasionally produced monuments characterized by a delicately balanced dialogue between the architecture and its glazing decoration. Saint-Père is one of these monuments.

Lillich’s study is divided into three parts. The first consists of a terse explication of the historical and architectural context of the original glazing and a survey of the documentation of its subsequent alteration or repair. This is followed by a stylistic analysis of each of the three major groups of clerestory windows: straight choir (ca. 1240–1250; reinstated ca. 1270), hemicycle (ca. 1295–1300), and nave (ca. 1300–1315). Lillich concludes the study by identifying these programs as the “Western School of Glass Painting” flourishing between ca. 1240 and ca. 1320 and as also responsible for stained glass at Le Mans, Tours, Sézene, Vendôme, and Évron. The definition of this stylistic group is perhaps Lillich’s most valuable contribution for the specialist in stained glass. An iconographic examination of the Saint-Père windows constitutes the final section of the book. After discussing the individual iconographic components in detail, Lillich defines a unified program. The Saint-Père clerestory depicts a history of the Christian church from the Old Testament prophets through the Incarnation to one of the earliest representations of the recently canonized Saint Louis.

Readers of this journal will be most interested in Lillich’s treatment of the relationship between the stained glass window and its architectural framework. Saint-Père was glazed during a period when the design of the clerestory window was being reevaluated, a period between the saturated, full-color windows of the first half of the 13th century (Chartres and the Sainte-Chapelle) and the 14th-century combination of color and grisaille known as the band window (Beauvais and Saint-Ouen at Rouen). Grisaille became popular in the middle of the 13th century not only because it was less expensive than colored glass but also because it transmitted more light into the interior of the church to illuminate the delicate carving of Rayonnant architecture. Lillich charts a period of restless experimentation between the two standard formulas during which the glazier sought ways to combine grisaille and colored glass in the design of a single window. (See also her article on this in Gesta, 1970.) The author’s perceptive analysis of Saint-Père and its context allows the reader to understand the way the glazier of the second half of the 13th century responded to the chal-