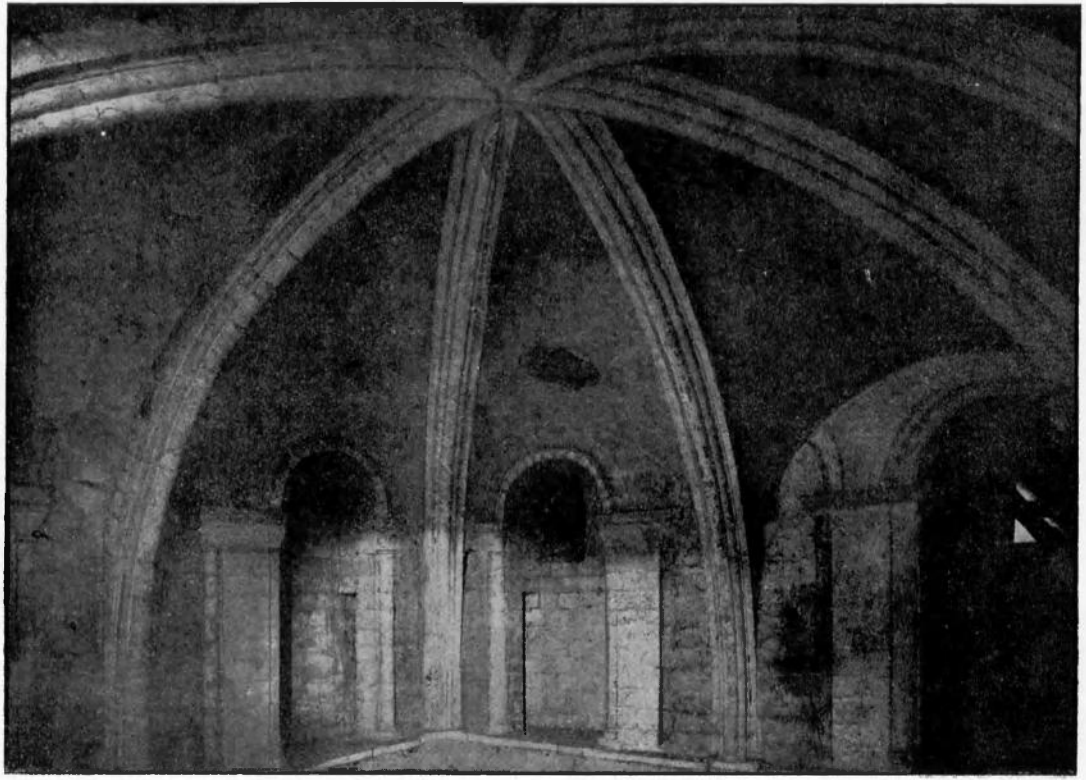


MONTIVILLIERS, VAULT OF CROSSING.
From a photograph by M. Henri Heuzé.

To face page 1.

THE NORMAN SCHOOL AND THE BEGINNINGS OF GOTHIC ARCHITECTURE. TWO OCTOPARTITE VAULTS: MONTIVILLIERS AND CANTERBURY.

By JOHN BILSON, F.S.A.

I. INTRODUCTION.

It has been said that the knowledge of Gothic is still young, and it is certainly true that much still remains to be done in the way of scientific investigation before we can know all that it is possible to discover of the earlier development which led up to the organization of the Gothic system. Perhaps what is now most wanted is accurate and thorough anaylsis of the more important and pertinent examples. The object of this paper is to describe and illustrate two of these examples, and to ascertain their bearing on the general story.

Before dealing with these two particular examples, it may be well for me to sketch briefly what I believe to be the true story of the development, so far as it can be ascertained at present.

The evolution by which what we call Romanesque architecture was gradually transformed into what we call Gothic was in its essence a constructional development. The structural problem which the Romanesque builders were continually trying to solve was how to cover with stone vaults the aisled church of the basilican type of plan. The problem was only successfully solved in churches with clearstory lighting by the introduction of the ribbed vault,[1] the thrust of which was abutted at first by walls or arches

[1] I use the term 'ribbed vault' as meaning the groined vault with diagonal ribs (Fr. *croisee d'ogives*), confining the term 'groined vault' to the *voûte d'aretes* (without diagonal ribs). As our current use of the term 'rib' is so wanting in precision, and so unsatisfactory as tending to obscure the function and importance of the *ogive*, I shall use the terms *doubleau* and *ogive*, instead of our cumbersome terms 'transverse arch' or 'transverse rib,' and 'diagonal rib' respectively. If it be objected that these are foreign terms, I reply that they are neither more nor less so than *tierceron* and *lierne*, which we have long since adopted (though our current use of the term *lierne* is erroneous). It is even more convenient to be able to use a single word for the more important 'diagonal rib.'

beneath the roof of the triforium, and afterwards by flying-buttresses above this roof. The complete solution was only reached by the aid of the pointed arch.

Since it became recognized that the three elements which made possible the triumphs of the Gothic system were the ribbed vault, the pointed arch, and the flying-buttress, and that of these three the first was much the most important, there has been much controversy as to the origin of the ribbed vault. It is universally recognized that, when once the school of the Ile-de-France came into possession of these elements, it developed from them a new system of construction, and clothed it with a new expression, which we call Gothic; and that the honour of this development undoubtedly belongs to the Ile-de-France. Some French archaeologists, however, have not been content with this, but have claimed for the Ile-de-France, not merely the development of the system, but the invention of the ribbed vault, though recently there has been a tendency to modify this view. The contrary opinion—and I believe undoubtedly the true one—is that the ribbed vault, in a rudimentary form and associated with forms which are otherwise quite Romanesque, was used in widely-spread districts before its use developed a new system of construction and a new expression. Of the examples in these different districts, and especially of the very important Lombard school,[1] I can here say nothing, but must confine myself entirely to the school of Normandy in relation to the origins of Gothic in the Ile-de-France.

The rapid and complete absorption by the Normans of the civilization of the country in which they had settled, stamping it with their own individuality; is a very remarkable historical fact. This is generally recognized as regards political organization,[2] and it is equally true of architecture. Their great churches have the air of expressing the character of a masterful race of conquerors. Their progress was

[1] I may, however, be permitted to remark that those who most strongly advocate the view that the Lombard school invented the ribbed vault, and exported it to north-west France, have given us extraordinarily little in the way of detailed analysis and illustration of their most important examples, and that their works rarely contain a drawing to scale of any vault system. Photography alone is quite inadequate for this purpose, and the chronological sequence of the structural development of the Lombard vaults still remains to be made out.

[2] 'La Normandie du XI^e siecle sera l'une des provinces ou se manifestera avec le plus d'eclat le genie français.' A. Luchaire, in *Histoire de France* (ed. E. Lavisse), vol. 2, ii, 42.

in the direction of the development of the structural organization of the building. Never strong in sculpture, it is in the expression of purely architectural form that their logical precision is to be recognized. In their most notable monuments, the advance is towards completely vaulted construction, the vaulting of the whole building. This was their aim, although its accomplishment was sometimes partial, sometimes even abandoned, to be taken up again later. In England, the impression given by different monuments is much more irregular—naturally enough in view of the fact that the impulse was not of native origin, and that the English tendency was always rather to decoration than to logical development of structure—and the monuments which evince the Norman spirit most clearly are the most advanced. Indeed in England this structural development was purely Norman, and it was due simply to the accident of the Conquest that the most remarkable evidence of the Norman advance in the latter part of the eleventh century is to be found in England rather than in Normandy itself.[1]

Although it was not given to the Norman builders to achieve the final solution of the problem, they had already by the second quarter of the twelfth century accomplished much in the direction of the Gothic system, and their accomplishment had a powerful influence on the early efforts of the school of the Ile-de-France. So long as their works fall within the limits of Romanesque, the builders of the Ile-de-France were in no way advanced, if indeed they were not decidedly backward. The distinction of this school is, not that it was foremost in preparing the way, but that, unfettered by any strong traditions, it took advantage of the progress which had been made elsewhere, and began in the second quarter of the twelfth century the evolution of a system of architecture which was soon to become predominant throughout western Europe.

In comparing the contribution of the builders of the Norman school towards the solution of the problem of vaulted construction with that of their contemporaries and predecessors, it is necessary to remember that their

[1] I need hardly repeat here that, in following the development of vaulted construction in the Norman school, it is in my view quite immaterial whether the examples are drawn from Normandy or from England.

efforts were limited to the problem of vaulting an aisled church *with a clearstory*, conditions which were essential to the final solution.[1] No method which involved the absence of high lighting would satisfy their requirements. A close study of their monuments shows that they had this in mind almost from the time when a distinctively Norman school can be said to have been formed. The organization of their pillars with a shaft running up the internal face of the high wall[2] can only be explained by the supposition that, in its original idea, this shaft was destined to receive an arch (as indeed it actually does in the unribbed vaults of the choirs of Saint-Nicolas and La Trinité, Caen), even if this original intention was often abandoned, and the shaft became merely a schematic division of the bays. The presence of abutting arches across the triforium under its roof[3] points to the intention to vault. The design of the original clearstory of the nave of Saint-Etienne, Caen—an arcade of four set closely in the middle of the double bay[4]—seems to indicate that its builders contemplated a vault,[5] though the intention was not carried out.[6] Indeed the vaulting of the principal spans of a great church with the unribbed groined vault involved considerable difficulties, which the adoption of the ogive removed.

[1] Had my friend M. de Lasteyrie overlooked this distinction when he wrote in his recent masterly work, 'Nulle part l'hesitation a faire emploi des voutes n'est plus frappante qu'en Normandie" (*L'architecture religieuse en France a l'epoque romane* (Paris, 1912), p. 485)? Even if it were true, as he says, that 'jusqu'au second quart du XII[e] siecle, aucune de ces eglises (normandes) n'a reçu de voutes sur la nef,' this would not necessarily make the Norman school especially backward, for if we search M. de Lasteyrie's book for examples before this date of vaults over clearstoried naves (distinguishing naves from choirs, as M. de Lasteyrie apparently does) we find none except a few Burgundian examples.

[2] The choir of Bernay shows what is perhaps the earliest example. See *Bulletin Monumental*, lxxv, 407 (1911).

[3] Chichester cathedral (choir), Durham (choir and transept), Norwich, all before the end of the eleventh century; and Durham (nave), La Trinite, Caen (nave), and, I think, the nave of Christchurch (Hampshire) in the first half of the twelfth century. The earliest example in the Ile-de-France is Saint-Germer (Oise), which cannot have been begun before the middle of the twelfth century, and moreover shows other indications of Norman influence. In view of these facts, it appears to me to be impossible to accept my friend Professor C. H. Moore's suggestion that to look elsewhere than to the Ile-de-France for this (or any other distinctive feature of the Gothic style) appears to be futile (*The Mediaeval Church Architecture of England* (1912), p. 36).

[4] G. Bouet, *Analyse architecturale de l'Abbaye de Saint-Étienne de Caen* (1868), p. 36 and figs. 30 and 32.

[5] This was evidently the opinion of M. de Lasteyrie in 1901 when he wrote of the 'grandes voutes d'aretes sur plan carre . . . qui ont du couvrir a l'origine la nef de Saint-Etienne de Caen' (*Discours sur les origines de l'architecture gothique*, in the *Bulletin de la Societe des Antiquaires de Normandie*. xxii. 64).

[6] M. Jules Viatte has argued that the nave of Jumieges was designed for groined vaults (*Bulletin archeologique*, 1913, pp. 93–117).

We must remember, however, that we can only base our study on what has survived, and that the greater number of the works which would have been most important for our purpose have disappeared. In England, for example, where so many great Romanesque churches have survived, the choirs (the most important part in this connexion) of only very few of them have escaped alteration or reconstruction to an extent which enables us to be quite certain how they were covered. Our proofs, therefore, must be gathered from only a small part of the evidence which must have been available if all the first attempts had survived for study.

These proofs, however, are sufficient to demonstrate conclusively that the builders of the Norman school were employing the ribbed vault from the last decade of the eleventh century.[1] As no serious attempt has yet been made to controvert these proofs,[2] they need not detain us here. What is more material for my present purpose is to endeavour to trace some chronological sequence of idea[3] in the system of the earlier ribbed vaults of this

[1] Choir aisles of Durham cathedral, begun 1093 (*Journal of the Royal Institute of British Architects*, 3rd ser. vi, 296–9).

[2] In his recent work (*L'architecture religieuse*, etc.), M. de Lasteyrie only refers to the vaults of Durham in a footnote (p. 497), and he does not even mention the earliest vaults, those of the choir aisles. With regard to the nave vault, his argument as to the meaning of *usque testudinem* does not touch the real question, for it is quite immaterial whether *testudo* here means vault or ceiling. The absolutely certain fact which he does not attempt to meet is that the clearstory stages throughout, including the choir, were built for and with the vaults, except in the south transept, where the construction of the clearstory (designed for a wooden ceiling) is entirely and significantly different from those of the north transept and nave, which were designed for the existing vaults. Moreover M. de Lasteyrie has not attempted to evolve a history of the building, consistent with the recorded facts, which supports his theory that the vaults are 'tout au plus contemporaines de celles de Saint-Denys,' nor has he ever met the arguments which I set forth in 1902 (*Journal R.I.B.A.*, 3rd ser. ix, 350–4). His suggestion that the greater width of the lowest voussoirs of the outer order of the doubleaux of the nave vault can only be explained by assuming that they were intended for *arcs diaphragmes* carrying a transverse gable-wall (p. 504) is untenable. Such walls, which must have had the improbable thickness of about 5 feet 6 inches, were certainly never built over the north transept, the vault of which is the earliest of the high vaults. The explanation is really quite simple. These wider voussoirs at the springing are precisely like those of the doubleaux of the south transept vault, which was built a little before that of the nave. In the latter, the outer order was narrowed so that the ogives should clear themselves better at their springing. I may add, too, that M. de Lasteyrie is silent as to such ribbed vaults as those of the transept aisles of Winchester, which were built as a consequence of the fall of the central tower in 1107, and those of the aisles of Peterborough, begun in 1117 or 1118, to say nothing of many other obviously early vaults which are less definitely dated.

[3] This does not, of course, involve the assumption that all vaults which exhibit characteristics which are early *in idea* are necessarily earlier *in date* than others which show more advanced method. The earlier methods lasted long in many cases, especially in England.

school which still exist, so that we may be able to place the two examples which I propose to discuss presently.

To begin with the simple groined vault without ribs, from which the ribbed vault was developed. The Norman groined vault was built of rubble, covered with plaster. It was built on a semi-cylindrical centering continuous in one direction, with similar centering applied on each side for the lateral cells.[1] As a rule, the crowns of the vault are level, or nearly so, but sometimes the crowns of the lateral cells rise or fall towards the walls.[2] If the bay is square, the lunettes of the lateral cells will be semicircular, and the curve of the groins will be practically a true ellipse. If the bay is oblong, with the short side next the walls, the curve of the lateral lunette was described on the wall, either as a stilted semicircle; or as a semicircle continued downwards by straight, or nearly straight, lines, sloping outwards towards the springing; or as a kind of semi-ellipse[3]; and from the curve so described on the wall the centres of the lateral cells were projected more or less at right-angles to the wall, to the back of the continuous semi-cylindrical centering in the opposite direction. Frequently in these cases, the groin does not lie in a vertical plane, but would be represented on plan by an irregularly curved line.[4] In any case, whatever the shape of the bay, and whatever the form of the vault, the groin is never a designed curve, but always simply the result of the intersection of the cells, or rather of the centering on which they were built.[5] And, what it is important to observe, *the geometrical structure of the vault was controlled by the semicircular curve of the doubleau.*[6]

[1] I do not, of course, intend to assert that the methods were always absolutely uniform, but what is stated here is, I believe, generally true of the majority of the examples which have survived.

[2] In the groined vaults over the aisles of the nave of Jumieges, the span of the transverse doubleaux is much less than that of the great arcades and of the lunettes on the aisle walls; the vaults were built on a continuous half-barrel centering longitudinally, and the crowns of the lateral cells rise considerably from the intersection of the groins to the main wall and aisle wall respectively (see Ruprich-Robert, *L'architecture normande*, pl. 13; A. Choisy, *Histoire de l'Architecture*, ii, p. 154 and fig. 9; and R. Martin du Gard, *L'abbaye de Jumieges*, p. 102 and pl. viii). The vaults of the north aisle of the nave of the priory church of Blyth, Nottinghamshire (founded 1088), are constructed in the same manner.

[3] Winchester cathedral, ambulatory of crypt.

[4] Saint-Nicolas, Caen, choir vault.

[5] I believe this to be true generally of groined vaults in rubble throughout France.

[6] Or, where the vault has no doubleaux, by the semicircular curve of the centering in one direction.

Before the introduction of the ogive, we find some examples which show that the Normans attempted to counteract the tendency of such a level-crowned vault to sag in the middle, by sloping the crowns of the cells upward from all four sides towards the intersection of the groins. This method was adopted in the vaults of the crypt of Winchester cathedral (begun 1079), and of the crypt of Gloucester cathedral (begun 1089).

But the weakest part of such a vault was the groin. Formed with stones roughly shaped with the axe, in the better constructed examples with the alternate courses bonded across the groin, sometimes however with scarcely any bond at all, there was considerable risk of failure, especially in vaults of comparatively large span. All these difficulties, and others too, were met by the introduction of the ogive, which was not a mere improvement in the construction of the groin, still less a merely decorative addition, but a real carrying arch supporting the cells, a higher development of the same idea which prompted the earlier introduction of doubleaux under groined vaults.

Was the Norman ribbed vault the independent discovery of the Normans, or did they adopt the idea from elsewhere? This is a question to which, in the present state of knowledge, I do not think it is possible to give a definite answer. There is a groined vault over the ground story of the north-west tower of Bayeux cathedral, which has, not diagonal ribs, but ribs crossing from the middle of each side of the square; this example, which is part of the work of bishop Odo, consecrated in 1077, is interesting as showing that the Normans were then already attempting to reinforce the groined vault, but similar examples are found in other districts.[1] The earliest dated example of the ribbed vault in the Norman school, over the choir aisles of Durham cathedral (begun in 1093), rudimentary as it is, scarcely gives the impression of being a first attempt. Whether the idea was imported from outside or not,[2] it is certain that the earliest Norman examples continue some

[1] Cormery (Indre-et-Loire), first floor of tower (R. J. Johnson, *Specimens of Early French Architecture* (London, 1864), pl. 94). Saint-Ours, Loches (Indre-et-Loire), tribune of west tower.

[2] The derivation of the Norman vaults from Lombardy is often asserted, but it has certainly never been proved. I am not clear whether we are to assume that the Lombard ribbed vault was developed from the groined vault with semicircular groins, such as those of the nave aisles of

of the methods of construction which they had already employed in the unribbed groined vault.

As in the unribbed vault, so in the ribbed vault, the cells were built of rubble covered with plaster, and this tradition lasted long, both in Normandy and England, where vault cells of regularly worked courses were only introduced after this method had been practised in the Ile-de-France. But it is in the geometrical setting-out of the arch-curves that we find the most interesting proofs of continuity of method.

The crypt of Winchester cathedral (begun 1079) affords an excellent illustration of the method adopted by the Norman builders in setting-out the arch-curves of groined vaults over bays of oblong or irregular plan, for the plan of the crypt[1] involved the vaulting of bays of very various shapes. The lunettes on the straight north and south walls of the central part of the crypt are set out as semicircles stilted a trifle more than the height of the springer blocks of the central arcade, and this stilted semicircle seems to control the whole setting-out. The doubleaux

Sant'Ambrogio, Milan. Dartein seems to have thought so (*L'architecture lombarde* part i, p. 54), but later writers on this subject have given us remarkably little in the way of definite information about the geometrical structure of the early vaults which they discuss. If, however, the Lombard ribbed vault was developed in this manner, it is quite certain that the Norman ribbed vault was not, and that the Normans could have borrowed from Lombardy only the mere idea of the ogive, and not the Lombard geometrical method of structure. Whether even this is possible has not yet been proved, for the early dates ascribed to the first Lombard ribbed vaults are by no means generally accepted. In view of the fact that an eleventh-century date is still frequently claimed for the nave of Sant'Ambrogio, Milan, it is well to note that the only documentary evidence hitherto available would place it in the first half or first third of the twelfth century (see Professor Baldwin Brown's admirable analysis of the evidence in the *English Historical Review*, xxvi, 362). Moreover, as has been pointed out, Signor Rivoira's theory proves too much. If the vaults of San Flaviano, Montefiascone, were built in 1032, and were of Lombard inspiration, the time required for the system to spread into central Italy necessitates its initiation in Lombardy being put back into the first quarter of the eleventh century. If therefore the Normans practically borrowed their architecture from the Lombards, through William of Volpiano and Lanfranc, as Signor Rivoira asserts, how is it that the Normans went on groping and experimenting towards a solution which they only reached some three-quarters of a century after it must have been solved in Lombardy? Montefiascone, however, is badly fitted to be the foundation-stone of such a wide-reaching hypothesis. I have not seen the church myself, but my friend M. Camille Enlart, who has studied it, has very obligingly communicated to me his notes and photographs. The plan of the piers shows that they were not designed for the actual vaults, and M. Enlart thinks that the latter may quite well be a 'repentir.' Moreover, he thinks that the date of the reconstruction of the church recorded by the inscription built into the present façade of the church (G. T. Rivoira, *Lombardic Architecture*, i, 211) ought to be read, not as 1032, but as 1302.

[1] For the plan of the crypt of Winchester, see Britton's *History and Antiquities of the See and Cathedral Church of Winchester* (1817), pl. ii; *Archaeological Journal*, lxiii, 111, pl. ii; and *Victoria County History*, *Hampshire*, v, 53.

over the narrower spans are stilted semicircles, and those over the wider spans are segments of circles struck from centres below the springing-line.[1] The spans of the doubleaux (including those of the aisle and ambulatory) vary between the extremes of 6 feet 9 inches and about 16 feet, with an almost constant height of about 6 feet.

The central part of the crypt[2] of Gloucester cathedral (begun 1089) retains its original groined vaults unaltered, and affords another example of the same method. The arches through the main north and south walls of the straight part of the crypt are semicircular, and so also are the doubleaux of the western bay of the two arcades which divide the central part of the crypt into three aisles. The second and fourth bays from the west, opposite the main piers of the side walls, are narrower, and the longitudinal doubleaux are stilted semicircles. The other longitudinal doubleaux, which are wider, and all the transverse doubleaux, are segments of circles struck from centres below the springing-line. The spans of the doubleaux vary between the extremes of 5 feet 9½ inches and 10 feet 3 inches, with a constant height of about 3 feet 4 inches.

Many other examples might be given to show that, before the introduction of the ogive, the current practice of the Norman builders, in groined vaults which necessitated doubleaux of different spans but of the same height, was to stilt the semicircular curves of the doubleaux of narrower span, and to adopt segmental curves for the doubleaux of wider spans. A careful examination will generally show that there is one semicircle, perhaps stilted, which controls the whole geometrical structure of the vault.

When the ogive was introduced, providing a permanent centre for the groin, the structure of the vault was profoundly modified, but it is not likely that the full advantages of the innovation would be realized at once. The Norman builders naturally adopted in the new construction the geometrical methods which they had been accustomed to practise in their groined vaults. Even where the bays

[1] Cf. the slightly earlier vaults of the undercroft of the dormitory at Westminster (*Archaeological Journal*, lxvii, 401).

[2] For the plan of the crypt of Gloucester, see Britton's *History and Antiquities of the Abbey and Cathedral Church of Gloucester* (1829), p. 50; F. S. Waller's *Gloucester Cathedral, Notes and Sketches* (1890), pl. ii; and *Archaeological Journal*, lxiii, 111, pl. ii.

of the vault were square, the ogive over the diagonal of the square necessarily had a much greater span than the doubleaux over the sides of the square, and in the earlier practice of the Norman builders the crown of the vault was generally approximately level, or at any rate the key at the intersection of the ogives did not rise very much higher than the crowns of the doubleaux.[1] As in their groined vaults, the doubleaux were semicircles, perhaps stilted; and the wider-spanned ogives were segments of circles, struck from centres below the springing line. This segmental curve was the nearest approximation, for a single arc of a circle, to the elliptical curve of the groin of the unribbed vault. There was, of course, a radically important structural difference between them. The elliptical groin, as has been pointed out above, was never a designed curve, but simply a result. The segmental ogive was a designed curve, and controlled the construction of the cells, which were built on centering boards placed between the ogives and the doubleaux or the lunettes on the walls. This independence of the ogive is shown, even in the earliest examples, by the pronounced ploughsharing of some of the cells above the springing, especially in vaults over oblong bays.[2] The point, however, which I wish especially to emphasize here is that, in this earliest stage of the development of the Norman ribbed vault, *the geometrical structure of the vault was controlled by the semicircular curve of the doubleau.*

The fact that this type of vault, with the segmental ogive, approximates most closely to the method of the earlier groined vaults, is a prima facie indication that it was the earliest in idea.[3] This is proved by the fact that the earliest known ribbed vaults of the Norman school are of this type, and it is confirmed by the persistence of this

[1] In this respect the majority of the early Norman vaults differ from such Lombard vaults as those over the nave of Sant'Ambrogio, Milan, where all the arches are approximately semicircular, and the crowns of the ogives rise much higher than the crowns of the doubleaux. However, this method is occasionally found in Norman tower vaults which are not of the earliest, as at Duclair (Seine-Inferieure), and less definitely at Douvres (Calvados). The vaults of the choir aisles of Saint-Germain-des-Pres, Paris, seem to follow the same system.

[2] Choir aisles of Durham cathedral (*Journal R.I.B.A.* 3rd ser. vi, 299).

[3] This, of course, does not mean that the segmental ogive is an absolute criterion of early date, for many vaults with segmental ogives were built after the first adoption of the semicircle for the ogive.

method in numerous examples of aisle and crypt vaults up to the middle of the twelfth century,[1] and by the segmental ogives of the quasi-sexpartite and sexpartite vaults of the Caen group.

An important step in the development was taken when the ogive was made semicircular, and thus became the controlling factor. The abrupt angle formed by the segmental ogive at its springing from its support was unsightly, and the low sweep of the segmental curve increased the thrust. The adoption of the semicircular curve for the ogive involved the stilting of the semicircular curves of the doubleaux, if the crowns of ogives and doubleaux were to be brought to approximately the same level.[2] This improvement would seem indeed to have been adopted almost from the first in high vaults over bays of oblong plan. Here the conditions were more favourable than in aisle vaults, where if the bay were square on plan both doubleaux—the transverse doubleau and the main arch—would have to be stilted very considerably, and if the bay were oblong one of the doubleaux must be stilted still more. In high vaults over bays of oblong plan, there was only the transverse doubleau to be considered, since the lateral lunettes could follow the quasi-elliptical curve which has already been noticed in the simple groined vaults[3]; and the more oblong the bay, the nearer the span of the ogive approached that of the transverse doubleau.

In the high vault of the north transept of Durham, where the two bays next the crossing are very narrow, the doubleau is only stilted very slightly, and the centres of the curves of the ogives are not very far below the springing-line.[4] In this vault, the structure is still controlled by the curve of the doubleau, though an accommodation of the curves of doubleau and ogive is consciously attempted.

[1] And even later, e.g. crypt of York cathedral, and south choir aisle of Christchurch cathedral, Oxford, both of the second half of the twelfth century.

[2] Even the earliest dated example which survives — the choir aisles of Durham, begun 1093—shows one of the doubleaux (the narrower-spanned) stilted, and the crowns of the ogives raised above the crowns of the doubleaux, though the pronounced oblong plan of the bays still necessitates ogives of a very low sweep (*Journal R.I.B.A.* 3rd ser. vi, 299, and fig. 10).

[3] Here again we have evidence of the continuity of development from earlier practice.

[4] For the ogives of the two bays next the crossing, the centres are below the springing to the extent of about one-seventh and one-ninth of the height from springing to crown. In the choir aisle, the centre is depressed below the springing more than one half of the height above (*Journal R.I.B.A.* 3rd ser. vi, 299, and fig. 10).

In the high vaults of the choir and transept of Lessay (Manche), which appear to me to be only slightly later than that of the north transept of Durham, the structure is controlled by the semicircular ogive, and the doubleaux are stilted to bring their crowns to nearly the same level.[1] This improved system is also followed in other later examples.

The geometrical methods adopted by the Norman builders in their earliest ribbed vaults have an important bearing on the question of the relative dates of the beginnings of the new system in the schools of Normandy and the Ile-de-France respectively. The earliest surviving example of the ogive in the Ile-de-France which has hitherto been noticed is, I believe, to be found in the vaults of the easternmost bays of the nave aisles of Saint-Etienne, Beauvais, which may date from about 1125. Here too the centres of the curves of the ogives are a little below the springing-line,[2] but, as the bays are less oblong on plan than those of the high vaults just noticed, the stilting of the doubleaux is much more pronounced. The geometrical structure is thus very much the same as that of the Norman vaults discussed above, which are not precisely the earliest either in date or in idea, and the internal elevation of the nave of Saint-Etienne shows decided similarity to those of the Norman school. So far as I am aware, no other early ribbed vaults in the Ile-de-France show this rudimentary method. The vaults of the ambulatory of Morienval, which in my judgement are a little later in date than the earlier vaults of Beauvais, are not easy to analyse, on account of their extremely crude execution and the irregular plan of the bays, but their system seems to be based on a semicircular curve for the ogive, and the doubleaux of the apse arcade show a rudimentary attempt to overcome the difficulties of varying spans by the use of

[1] In the *Bulletin Monumental*, lxxii, 502, I inadvertently included the vaults of Lessay among those with segmental ogives. I have measured those of the choir and north transept, and their method is based on the semicircular ogive.

[2] I have to acknowledge an error in what I have previously written on these aisle vaults of Saint-Etienne, Beauvais, when I stated that the ogives were true semicircles (*Bulletin Monumental*, lxxii, 134, 503). I have since measured the vaults of the two easternmost bays of the south aisle, and the centres of the curves of the ogives are from 9 to 11 inches below the springing-line.

the pointed arch.[1] This last, indeed, is an essential characteristic of almost all the earliest ribbed vaults of the Ile-de-France.

The conclusions here set forth as to the relative dates of the earliest ribbed vaults of the schools of Normandy and the Ile-de-France are thus amply confirmed by an analysis of their method and structure. The earliest examples in the Ile-de-France do not show that continuous development based on the methods of the unribbed groined vault which are to be recognized so clearly in the earlier examples of the Norman school. In the Ile-de-France, the earliest stage in the development is missing, for even the vaults of Saint-Etienne, Beauvais, are not of the earliest type, though they stand practically alone among the early vaults of the school of the Ile-de-France. It is sufficiently significant, too, that this early stage should be missing at a time (the end of the eleventh, and beginning of the twelfth century) when the architectural character of the buildings of the Norman school was so much in advance of what was being done in the Ile-de-France. Everything indeed seems to point to the conclusion that Normandy accomplished much in the direction of Gothic construction, but, resting on its achievement, failed to reach a complete early Gothic manner; that, on the other hand, the Ile-de-France, having done little in the way of preparation,[2] and being less hampered by tradition, advanced rapidly to the first place, and evolved the system of construction and manner of expression which we call Gothic. The Norman contribution to the earlier stages of the development is, however, on that account none the less important to the history of architecture.

We have now to consider a further stage in the develop-

[1] In my opinion, the importance of these much-discussed vaults of Morienval does not consist in their showing one of the earliest attempts in the construction of a ribbed vault, as has been often contended (I think, quite erroneously), but as an early attempt to overcome the difficulties of vaulting the irregularly shaped bays of an ambulatory.

[2] 'L'ecole française fut l'ouvriere efficace de la Transition et du gothique primitif, personne aujourd'hui ne s'avise plus de la révoquer en doute. Mais les elements organiques du style ogival, l'ogive, l'arc brisé, l'arc boutant . . . elle ne les a, selon toute vraisemblance, ni inventes, ni réinventés. Ils lui ont ete apportes du dehors; son genie a ete de les assembler et de faire fructifier le germe que cet assemblage contenait.' Anthyme Saint-Paul, *Les coupures et les formules dans l'archeologie medievale*, in the *Revue de l'Art Chretien*, lxii (1912), 264.

ment of the Norman ribbed vault, which has an important bearing on this question—I refer to the sexpartite vault. It is obvious that the sexpartite vault could not have been invented if the simple quadripartite vault had not already been known. The two systems, quadripartite and sexpartite, are found together at Saint-Étienne, Caen, in works which are practically contemporary, and the quadripartite vaults over the arms of the transept show by their character that they must not be reckoned among the earliest ribbed vaults of the Norman school. Moreover we find in Normandy, not only the sexpartite vault of the usual form,[1] but also a similar though much less developed form, which is not really a sexpartite vault at all, but a quadripartite vault over a double bay divided by an intermediate doubleau carrying a wall.[2] It is true that the actually surviving examples of this quasi-sexpartite form do not seem to be so early in date as the sexpartite vaults of the nave of Saint-Etienne, Caen,[3] but there can be no doubt that the former must be regarded as an intermediate stage in the development from the quadripartite to the sexpartite form. Unfortunately none of these vaults can be precisely dated by documentary evidence, but the system and character of the nave vaults of Saint-Etienne seems to justify the conclusion that they cannot be later than c. 1130[4]; and we shall see presently that this conclusion is confirmed by the study of the vaults which form the more special subject of this paper. It is con-

[1] Such as those over the naves of Saint-Etienne, Caen, and Creully (Calvados).

[2] Sainte-Trinite, Caen, nave; Bernieres-sur-Mer (Calvados), nave; Saint-Gabriel (Calvados), choir.

[3] The vaults of Bernieres-sur-Mer and Saint-Gabriel are quite certainly later, and the vaults of the nave of Sainte-Trinite, Caen, seem to have been slightly later, than those of the nave of Saint-Etienne. The actual vaults of the nave of Sainte-Trinite are new, built by Ruprich-Robert in place of the wood-and-plaster vaults which had superseded the original vaults, but there seems to be no doubt that they reproduce the original form (see Ruprich-Robert, *L'eglise Sainte-Trinite et l'eglise Saint-Étienne, Caen* (Caen, 1864), p. 36). The vaults of the transept arms, which seem to belong to the same building-campaign, are quadripartite, except the extreme bays next the gables, which are quinquepartite, and here the cells follow the system of the sexpartite vault, not that of the quasi-sexpartite form of the nave vault.

[4] 'Les voutes normandes (i.e. of the Caen group) peuvent tout aussi bien remonter a 1130 qu'a 1160: leur date exacte est un probleme dont nous n'avons pas encore la solution.' So wrote M. Louis Regnier in 1895 (*Memoires de la Societe historique et archeologique de Pontoise et du Vexin*, xvi, 119). M. de Lasteyrie has recently given us a criterion for an approximate date for the vaults of the Caen group when he fixed the date of the vaults of Montivilliers as before 1148 (*L'architecture religieuse en France a l'epoque romane*, p. 497, n. 2).

firmed, too, by a comparison of the nave vaults of La Trinité, Angers, which are evidently of Norman inspiration, with the known date of the nave vaults of Angers cathedral. The structural idea seems to have been to stiffen the rib-skeleton of the vault, and to counteract the tendency of the wide-spanned ogives of low curve to settle at the crown.[1]

The geometrical structure of the quasi-sexpartite and sexpartite vaults of the Caen group follows the system already discussed above. The crowns of the vaults are generally nearly level, at any rate in the longitudinal direction.[2] The curves of the doubleaux are generally semicircular, more or less stilted. The great width of the double bay involves a great difference between the span of the ogive and that of the doubleau, and the curve of the ogive is a segment of a circle struck from a centre considerably below the springing-line.[3] In the sexpartite vaults, the lunettes follow the quasi-elliptical curve already noticed.

The sexpartite vault is a characteristic feature of the system of the important group of early Gothic churches of the school of the Île-de-France, but it does not seem to have made its appearance there before the last decade of the first half of the twelfth century. The earliest existing examples are much more advanced in character than those of the Caen group, and their geometrical system shows full knowledge of the advantages of the pointed arch, which is used for the doubleaux, and generally for the lunettes of the lateral cells.[4] Nowhere do we find examples of an experimental stage leading up to the final form. In Normandy, on the contrary, we find the intermediate quasi-sexpartite form, and the geometrical system of the

[1] It is not improbable that the idea of the ridge-rib (lierne) may have been ultimately derived from the Norman quasi-sexpartite vault (see *Journal R.I.B.A.* 3rd ser. xix, 737).

[2] In the vaults of the nave of Saint-Etienne, Caen, the crowns of the ogives are not more than 1 foot above the crowns of the doubleaux and of the lunettes (so far as the rubbish on the top of the vaults enables one to judge).

[3] See Ruprich-Robert, *L'architecture normande*, i, 143.

[4] In the choir vault of Sens cathedral, the remains of the original wall-ribs indicate that they were semicircular (Viollet-le-Duc, *Dictionnaire*, ix, 508, and figs. 23 and 24), and the original vault of this choir is probably the earliest instance of the sexpartite vault in this school. The choir was begun by archbishop Henri le Sanglier, who died in 1142 (Ch. Poree, *Les architectes et la construction de la cathedrale de Sens*, in the volume of the *Congres archeologique de France tenu a Avallon*, 1907, p. 562). The earlier Norman ribbed vaults generally have no wall-ribs, though the wall-arch was frequently used with the unribbed groined vault (e.g. undercroft of dormitory at Westminster, St. John's chapel in the Tower of London; crypt of Bow church; choir aisles and chapels, Gloucester cathedral).

whole group simply continues the methods of the earliest quadripartite vaults. We are justified, therefore, in believing that the sexpartite vault was the independent discovery of the Norman school, and that the early Gothic school of the Ile-de-France profited by what had already been done by its neighbour in this direction.

So far had the Norman school advanced in vault construction before the building of the two examples which will now be described in detail. Their bearing on the general question will be discussed in the concluding part of this paper.

II. MONTIVILLIERS.

Montivilliers[1] was one of the old monastic foundations revived by duke Richard II. It was an abbey of Benedictine nuns, and we are told that the second abbess, Elizabeth, who succeeded before 1066, and died before 1116 or 1117, was believed to have built the existing church *a fundamentis*.[2] The church, although considerably altered in later times, retains in the main its original plan, and the greater part of its original structure. Its plan is analogous to those of other monastic churches of the Norman Romanesque.[3] It has a choir of three straight bays, ending in an apse of five bays, and flanked by aisles which finish on the line of the springing of the great apse with apses internally, square externally.[4] The transept arms are each two bays in length, the inner bay on each side of the crossing being opposite to the aisles of the choir and nave, and the outer bay of each arm is flanked on the east by an apsidal chapel; these last have the peculiarity of a rectangular bay opening from the transept in front of the apse.[5] So far the work belongs to the last quarter of the eleventh century. The nave of eight bays flanked by aisles, at the west end of each of which is a tower, was a somewhat later instalment of the same general building-campaign. The ground-story of each of the western towers

[1] Seine-Inferieure, in the valley of the Lezarde, 3 miles north of Harfleur.

[2] *Gallia Christiana*, vol. xi, col. 282.

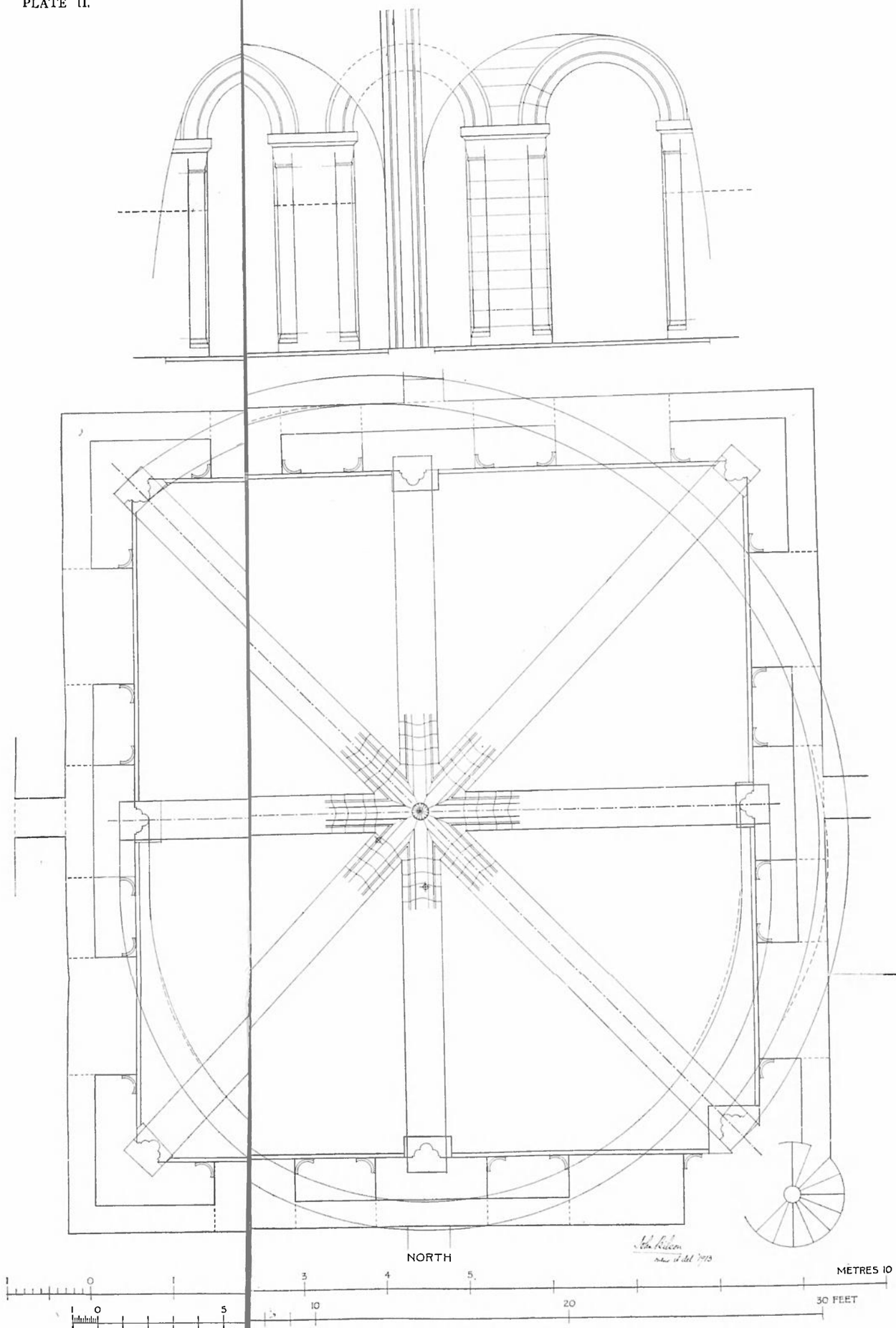
[3] *Archaeologia*, lxii, 554.

[4] For plan of the east end, see *Archaeological Journal*, liii, 17, pl. 3.

[5] This arrangement can be clearly recognized on the south side.

PLATE II.

To face page 17



MONTIVILLIERS, VAULT OF CROSSING.

formed a chapel, and the north-western tower retains its apse recessed in the east wall.[1]

The upper part of the choir has been so much altered that it is difficult to say how it was covered originally, but the transept (including the crossing) and the nave were not vaulted. The crossing is carried up as a lantern tower, in the characteristic Norman manner. Above the crossing arches, the tower is of three stages. The lowest stage has, on each of its four sides, three semicircular arched openings in front of a wall-passage (plate II). Each jamb of these openings has a three-quarter attached shaft, with a plain convex cubic capital of the same special type as those of the eleventh-century choir, and the arches are moulded with the angle-roll and quirked hollow on the face which is characteristic of the work of the last quarter of the eleventh century at Caen and elsewhere in Normandy and England. The wall at the back of the wall-passage is pierced in the middle of each side by a small door giving access to the roof-spaces of the four arms abutting against the tower. The middle stage has a similar wall-passage, with three semicircular arched openings on each side, but the jambs are plain[2] and the unmoulded arches spring from a chamfered impost-string. Windows are pierced opposite the two end arches on each side, but not opposite the middle arch, which is partly masked externally by the roofs. On the outside, this stage shows an arcade of five on each face, with a roll-moulding to the jambs continued around the arch, which has the quirked hollow noticed inside the stage below. A little above the internal arcade, the walls are diminished in thickness, and this internal set-off doubtless indicates the level of the original flat ceiling of the lantern. The upper stage has, on each side, three windows with three orders of jamb shafts, from which spring moulded semicircular arches. All these stages are continuous work, probably finished early in the twelfth century, while the nave was going on; the west doorway of the nave and the north-western tower were only finished somewhat later.

[1] So also in the basement story of the western towers of Graville-Sainte-Honorine (Seine-Inférieure).

[2] Except the jamb on each side of the projection for the staircase in the north-west angle, which has a shaft (as in the stage below), but this idea was abandoned before the other jambs were built.

Towards the end of the first half of the twelfth century (the date will be discussed presently), vaults were added to the whole transept, including the crossing. These vaults were executed in a single building-campaign, though the vaulting of the north transept is slightly more advanced than that of the south transept.

The vaulting of the south transept[1] is divided into two bays, the pronounced oblong plan of which is dictated by the original (late eleventh-century) plan of the transept arm. On the east side, the original half-shaft dividing the bays remains, and was provided with a new capital and corbel-supports to receive the ribs of the added vault. These corbel-supports, as well as those inserted to the pilasters in the eastern angles, are set diagonally, normal to the direction of the ogives. On the west side, the pilaster dividing the bays is of the date of the vault, and is decorated with a lozengy pattern between angle-rolls, which is continued on the doubleau which it receives, with only the intermediary of an impost moulding, in continuation of the abaci of the corbel-supports for the ogives. The curve of the doubleau seems to be a stilted semicircle. The ogives appear to be semicircular, or nearly so,[2] and are moulded with the triple roll flanked on each side by a fillet and flat, which is the profile of the doubleaux and ogives of the crossing vault. The cells are of rubble, covered with plaster, and the lunettes on the side walls are of the tall quasi-elliptical form noticed above. As the bays are so narrow in proportion to the width of the transept, the crowns of the lateral cells fall very considerably from the keys of the ogives to the lunettes on the side walls. Longitudinally the crowns of the cells appear to be approximately level.[2] The lunette on the south wall seems to be nearly semicircular. This south end is divided centrally[3] by a pilaster, decorated with a lozengy pattern and finished with an impost moulding, like the pilaster on the west wall. The southern cell of this bay of the vault

[1] Ruprich-Robert, *L'architecture normande*, ii, pl. 95.

[2] These observations are subject to the reservation that they are judged by the eye only, for I have not actually measured the vaults of the north and south transepts.

[3] This division of the transept ends into two bays is found at Jumieges, Mont-Saint-Michel, Saint-Etienne, Sainte-Trinite, and Saint-Nicolas, Caen, Lessay, and Saint-Georges-de-Boscherville; also at Winchester, Ely, St. Albans, Chichester, Romsey and Southwell.

has a ridge-rib (lierne) running from the key of the ogives to the south wall, where it returns vertically down the face of the wall to the top of the pilaster just mentioned.[1] None of the lunettes have wall-ribs.

The north transept is similarly vaulted in two bays, with some slight differences in the supports, and with some remarkable differences in the vault itself. The ogives are moulded with a triple roll flanked on each side by a fillet, as before, but instead of the plain flat beyond the fillet, the angle is chamfered, and decorated with pellets. As in the south transept, the lierne is moulded with a triple roll. Here, however, the lierne runs the whole length between the keys of the ogives of the two bays, and in each of the extreme half-bays it curves down from the key of the ogive to a corbel on the wall, these quadrant ribs carrying a spandrel of wall under the crown of the vault cell. This is obviously an arrangement which can only have been inspired by the quasi-sexpartite vaults of the Caen type, and proves that the vault must be later in date than the appearance, at any rate, of this type of vault in the Caen district. Both its system and its decorative details indicate that this vaulting is slightly later in date than that of the south transept.

The octopartite vault of the crossing (plates I[2] and II), which is the more immediate subject of this notice, was inserted in the lower of the three stages of the central tower described above, the bottom of the stage being a little above the crowns of the crossing arches, and at about the levels of the tops of the side walls of the nave and transept. The vault is concealed from view by a later vault which was inserted at a lower level in 1648, as is recorded by an inscription on the corbels in the four angles,[3] and this doubtless is the reason why the earlier vault has hitherto entirely escaped archaeological notice.[4]

The stage in which the vault is inserted rises from a

[1] A similar arrangement of later date is found in the western bay of the north and south aisles of the nave of Bernieres-sur-Mer (Calvados).

[2] I owe the photograph reproduced as plate I to the kindness of M. Henri Heuze, one of the secretaries of the Societe française d'archeologie, who took it specially for me.

[3] The date is on the corbel of the north-east angle.

[4] I should not have known of it but for the kindness of my friend Dr. Coutan, of Rouen, and I am very glad to have had the advantage of examining it with him, and also with M. Louis Regnier.

string-course, chamfered on its upper and lower edges, which forms the sill of the arcaded wall-passage. The supports for the eight ribs of the vault have been inserted in this string-course, the tops of the abaci being level with the top of the string; little more than the capitals can now be seen, what is below them being almost entirely covered by the later vault. In three of the angles, the ogives spring from capitals set diagonally, over small square angle-pilasters, similar to those in the angles of the south transept, and, as there, the necking and scallops are continued on the wall-face a little beyond each side of the pilaster. In the fourth (north-west) angle, where the staircase is placed, the angle pier is much larger, and its capital is set square. The capitals are scalloped, of varying patterns and rather advanced type.

The vault is octopartite, with ogives springing from the angles, and doubleaux springing from the middle of the sides of the square of the tower. In order to provide abutment for the doubleaux, the middle opening of the arcade in front of the wall-passage on each side was walled up when the vault was built, but the passage itself was not blocked.[1]

The geometrical structure of the vault follows the system already discussed—stilted semicircles for the narrower spans (doubleaux), and segments of circles for the wider spans (ogives), but the stilt of the doubleaux is greater, and the depression of the curve of the ogives is less, than in the earliest examples of this system.

As this stage of the tower is not exactly square internally, the spans of the doubleaux and ogives respectively, and consequently their curves, differ a little.[2] The height from the springing (top of abaci of supports) to the underside of the key is 15 feet $5\frac{1}{2}$ inches. The spans of the doubleaux are 26 feet 2 inches (north to south) and 24 feet $11\frac{1}{2}$ inches (east to west), and their curves are semicircles stilted 2 feet $4\frac{1}{2}$ inches and 3 feet respectively. The spans of the ogives are 34 feet 7 inches (north-west to south-east) and 35 feet 8 inches (north-east to south-west), and the centres

[1] See the elevation of the south side on plate II.

[2] In plate II the dotted centre lines of the doubleaux and ogives on the plan represent the springing-lines on which the curves of each are set up.

of their curves are therefore 1 foot 11½ inches and 2 feet 6½ inches respectively below the level of the springing.[1]

The vault has no wall-ribs, and the junction of the cells with the walls forms the tall quasi-elliptical curve already noticed, the upper part of the curve being adapted to fit the extrados of the arches of the wall-arcade which was in existence before the vault was inserted.[2] The crowns of the cells fall steeply towards the walls, the average height of the crowns of the lunettes being about 4 feet 2 inches below the crowns of the cells at the key. The cells are constructed of rubble, which seems to be about 14 inches thick,[3] and have been built on straight centering (i.e. they are not concave in *both* directions, and the section of their crowns shows a straight line). The rubble cells have been plastered on the underside as usual.

The doubleaux and ogives are each 1 foot 6½ inches in width, and are built of thin stones, averaging about 6 inches in height. Tney are moulded alike, with a triple roll, the outer rolls flanked with a small fillet and a broad flat face (fig. 1, no. iv). The key is a well worked octagon, and has a small rose of sixteen leaves or petals on the intersection of the middle rolls.

In the absence of any documentary evidence as to the building of this vault, we can only form an opinion as to its approximate date from its character. The system is the same as that of the sexpartite vault, applied to the four sides of a square. Its geometrical structure is the same as that of the sexpartite vaults of the nave of Saint-Etienne, Caen, but the stilting of the doubleaux is more pronounced. As there was here no question of placing windows high up in the lunettes, the crowns of the cells slope much more steeply than, for example, those of Saint-Etienne, Caen.[4] The absence of wall-ribs is usual in all these early vaults of

[1] The curves are here described as true arcs of circles, and they are so drawn on plate II. As a matter of fact, however, the curves are deformed to some extent, as is generally the case in these early vaults. The extent of the deformation is indicated by the dotted lines by the sides of the curves of the ogive and doubleau as projected on the plan. The curves of each were measured at seven points (including springings and crown), following the convenient method suggested by Prof. Willis in his paper *On the Construction of the Vaults of the Middle Ages* (*Transactions of the Royal Institute of British Architects*, vol. i, part ii (1842), pp. 62–3).

[2] See the elevation of the south side on plate II.

[3] The cells of the vaults of the nave and transept of Saint-Etienne, Caen, are also about 14 inches thick.

[4] See p. 15, n. 2.

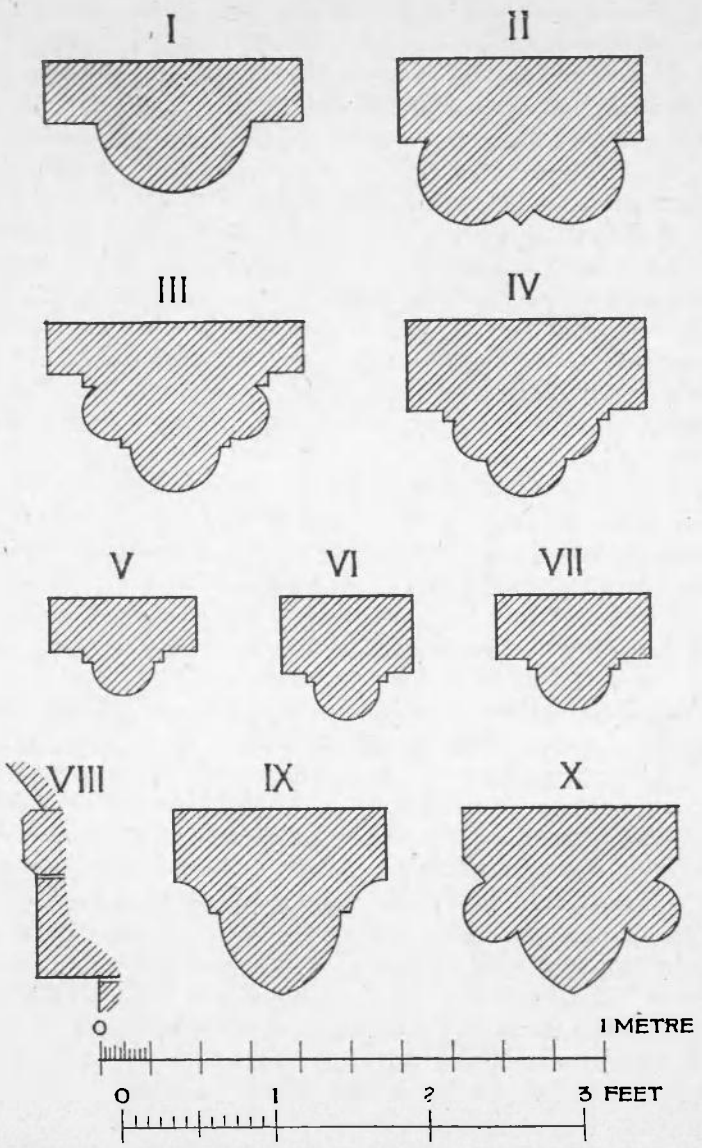


FIG. I. PROFILES OF OGIVES, ETC.

I. Lessay, choir. II. Saint-Paul, Rouen, choir. III. Saint-Etienne, Caen, north transept. IV. Montivilliers, crossing. V. Canterbury, Treasury, sub-vault. VI. Canterbury, Treasury. VII. Bernieres, aisle. VIII. Canterbury, Treasury (wall-arch). IX. Rouen cathedral, Tour Saint-Romain, ground story. X. Ditto, first floor.

the Norman school. The diagonal placing of the supports of the ogives, which is found also at Caen, does not occur in the earliest Norman examples, in which the builders followed their earlier tradition before they arrived at the more logical method.[1] The rose on the key of the ogives of the crossing vault is not found in any of the early Norman examples,[2] and does not occur at Caen.

The profile of the doubleaux and ogives belongs to a type which is a development from the simple large roll flanked by a flat face on each side, which is one of the most primitive arch mouldings of the Norman school,[3] and is the profile of the ogives in the high vaults of the choir and transept at Lessay (fig. 1, no. i). One of the earliest examples of the developed form in ogives is to be seen in the choir vault of the old church of Saint-Paul, Rouen, where two rolls separated by an angular fillet are flanked by flat faces (fig. 1, no. ii). In the Caen group of vaults, the usual profile is three rolls applied, as it were, to the flat face. In the high vaults of the nave and transept of Saint-Etienne, Caen, the three rolls are separated and flanked by small fillets (fig. 1, no. iii)[4] In the high vaults of the transept of Sainte-Trinité, Caen, there are fillets between the outer rolls and the flat faces, the precise profile in this crossing vault of Montivilliers.

The character of the details of the added supports, both of the crossing vault and of the vaults of the transept at Montivilliers, is more advanced than those of the nave of Saint-Etienne, Caen, and indicates a slightly later date. The presence of liernes in the transept vaults points in the same direction, and, as I have said above, the curious spandrel of wall which finishes the ends of the liernes in the north transept vault can only be due to a copying from the quasi-sexpartite vaults of the Caen group.

These considerations seem to me to justify the attribution of the crossing vault to about 1140. The vault of the

[1] 'Pour les supports, par exemple, le constructeur s'arrete d'abord a des formes traditionnelles' (J. A. Brutails, *L'archeologie du moyen age*, p. 144).

[2] In the vaults of the transept at Montivilliers the keys are not ornamented.

[3] It occurs at Bernay in the arcade arches of the choir and nave, and in the doubleaux of the choir aisle vaults.

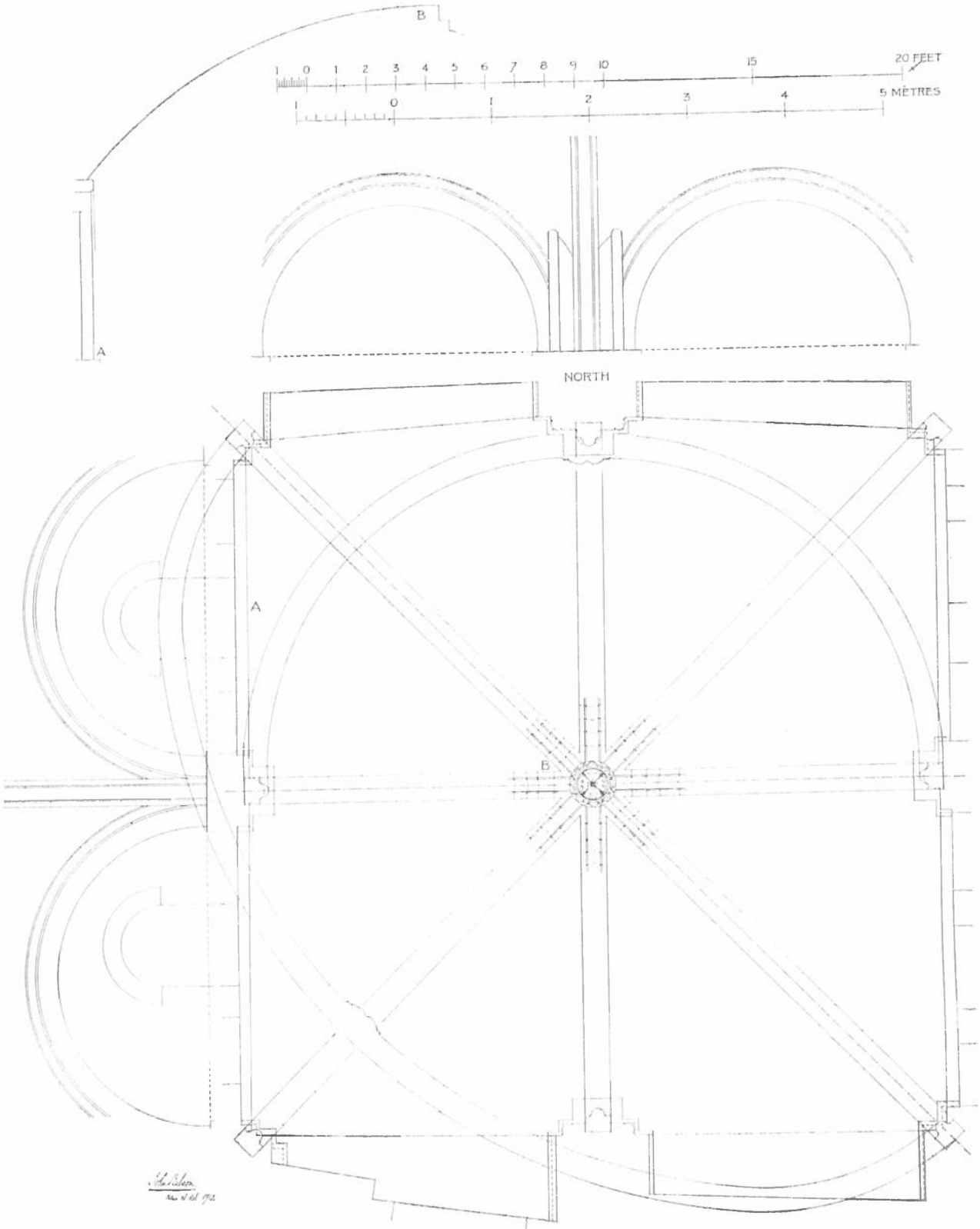
[4] So also in the nave vault of Ouistreham. At Bernieres-sur-Mer (nave), Saint-Gabriel (choir), and Colleville-sur-Orne (choir), there are fillets only between the rolls, and this is the profile of the inner order of the arch of the staircase to the North hall at Canterbury. At Fontaine-Henri (choir), the three rolls have the flat face on each side, but no fillets.

north transept, which is the most advanced of the three, can scarcely be later than about 1150. We shall find some confirmation of this dating when we come to consider the Treasury vault at Canterbury. I am glad to find myself here in agreement with my friend, M. de Lasteyrie, and all the more so because he has consistently opposed what I believe to be the true view as to the early development of rib-vaulted construction in the Norman school, and its relation to the beginnings of Gothic in the Ile-de-France. In his recent work he mentions Montivilliers among other Norman examples, some of which he thinks may be anterior to 1150, and in support of this opinion he cites the choir vault of the cathedral of Cefalù in Sicily, which must have been built before 1148, and, he thinks, seems to be inspired from the vaults of Montivilliers.[1] I should not myself have dared to draw a conclusion from so distant a source, especially as the doubleaux of the choir vault of Cefalù are pointed. So far, however, from regarding these vaults of Montivilliers as among the earliest examples of the ribbed vault in Normandy, they take their place after a long course of earlier development in this school, beginning with the simple quadripartite vault, and passing through the quasi-sexpartite and true sexpartite forms to the octopartite vault of this crossing ; and the dates of our earliest examples in England prove that the first of these stages must be set back nearly half a century behind the date which M. de Lasteyrie and I agree to assign to these vaults of Montivilliers. They are purely Norman in their system and character, and owe nothing to any outside influence. If the Norman school could arrive independently at the octopartite system of the crossing vault, and the liernes of the transept vaults, it is obvious that a considerable period of time must be allowed for the precedent development, and the sequence of this development can be followed with the assistance of the landmarks furnished by the few early examples of which the dates are proved. These vaults of Montivilliers, too, are important because they show how far Normandy had advanced before any influence from the Ile-de-France began to make itself felt, and the same thing is shown for England by the Canterbury vault now to be considered.

[1] *L'architecture religieuse*, p. 497, n. 2.

PLATE III.

To face page 25.



CANTERBURY, VAULT OF TREASURY.

III. CANTERBURY.

THE VAULT OF THE TREASURY.

The eastern arm of the cathedral church which Lanfranc built in the seven years after he became archbishop in 1070 was very soon replaced by the great eastern extension which was built for the most part in archbishop Anselm's time under priors Ernulf and Conrad. This was begun in the last years of the eleventh century,[1] and dedicated in 1130.[2]

Between this date and the great fire of 1174, much building was done around the cathedral, and what remains (though its architectural character has never yet been adequately analysed) admirably illustrates the latest phase of Romanesque as interpreted by the Canterbury builders, before the advent of the new influences which were introduced here by William of Sens in the great reconstruction which he began after the fire.

One of the most important of these buildings of the middle half of the twelfth century is the Treasury. It was built between the wall of the south aisle of the Infirmary hall and the north wall of St. Andrew's chapel,[3] the northernmost of the three chapels which opened from the ambulatory of Anselm's extension of the church. As these two walls were not parallel, the site of the Treasury was irregular, though this was minimized by the arrangement of the piers and recesses of the north and south walls of both stories.

The Treasury is built over a basement story, with open arches on its eastern and western sides. This basement is vaulted in four bays (two each way), with a central pillar. The plan of the supports—single half-shafts to the wall-piers, and four half-shafts on pilasters to the central pillar—while it would suit well enough unribbed groined vaults like those which had been built over the crypt of the great eastward extension of the church, is not adapted for the ribbed vaults which were actually built, and the ogives spring very crudely from the internal angles between the

[1] R. Willis, *The Architectural History of Canterbury Cathedral* (London, 1845), 17, 137.

[2] *Ibid.* 19.

[3] R. Willis, *The Architectural History of the Conventual Buildings of the Monastery of Christ Church in Canterbury* (London, 1869), 75–6, and figs. 5 and 6.

springers of the doubleaux. The doubleaux, which are unmoulded, follow the earlier tradition of ashlar voussoirs to the angles, with a strip of plastered rubble on the soffit between them; their curve is a semicircle, slightly stilted. The ogives are segments of circles, struck from centres below the springing line; their profile (fig. 1, no. v) is practically the same as that in the Treasury itself, and their keys have sculptured ornaments over the intersection of the rolls. The cells are of rubble, plastered, and their crowns rise from 5 to 7 inches from the crowns of the doubleaux to the keys of the ogives. The masonry of the basement, like that of the upper story, is fine-jointed, and is well executed, except as regards the awkward springings of the ogives.[1] Inside the Treasury the courses of the masonry are from 7 to $8\frac{1}{2}$ inches high.

The Treasury[2] above, which is approached from St. Andrew's chapel, is practically square on plan (plate III), measuring about 23 feet from north to south, and 22 feet 9 inches from east to west, within the pilasters which receive the wall-arches, the want of parallelism between the north and south walls being masked by the deep-arched recesses on these two sides, though the plan of the wall-piers still leaves some irregularity in the plan of the vault. The supports at the four angles are pilasters of slight projection; those in the middle of the east and west sides consist of a single half-shaft on the face of a broad pilaster; while the similar supports in the middle of the north and south sides form an additional projection in front of the square jambs of the arched recesses. These supports are not well arranged to receive the actual vault; they look rather as if they might have been designed for unribbed groined vaults of four bays, with a central pillar, as in the basement below. The angles provide no independent support for the ogives; the supports in the middle of the north and south walls provide a pilaster too much for the vault, and above the abaci these are carried up vertically with rolls on the edges, until they die into the cells of the vault

[1] The vaulting of the basement is described and illustrated by Professor C. H. Moore in his *Mediaeval Church Architecture of England*, pp. 21–2, and figs. 18 and 19.

[2] The Treasury building is described in Willis' *Monastery of Christ Church*, pp. 74–8.

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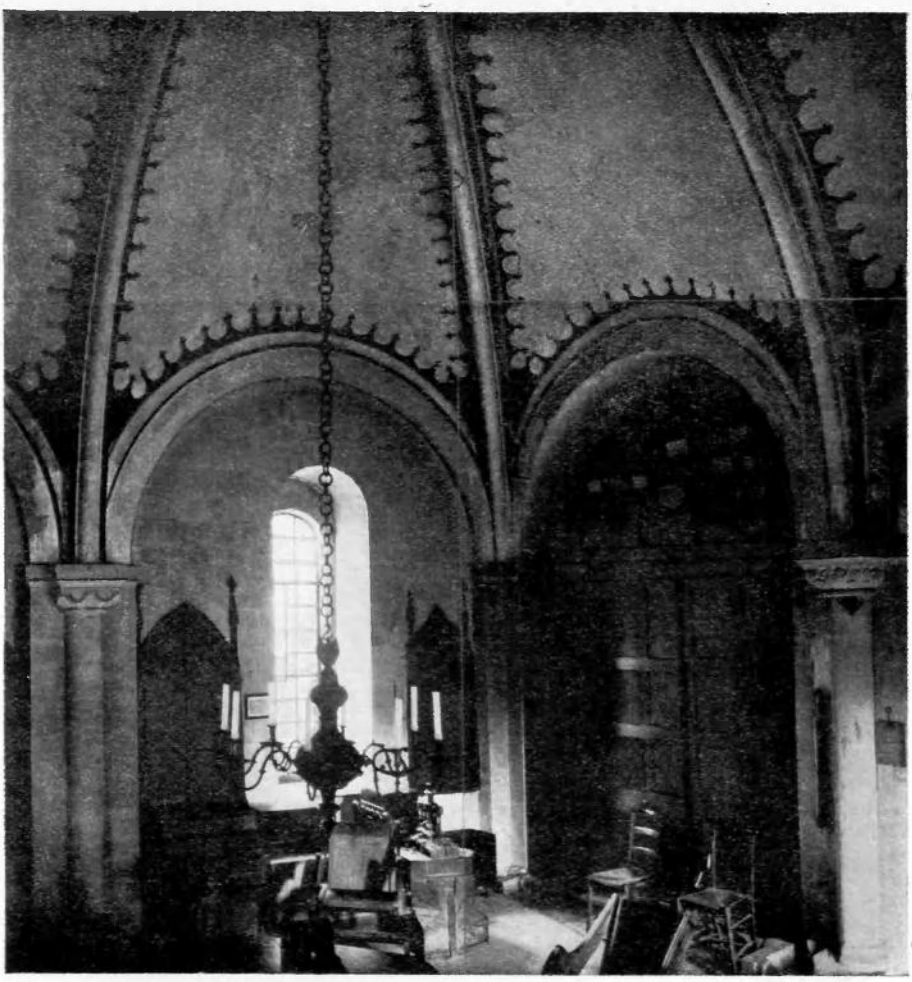


[*J. V. Saunders, phot.*

CANTERBURY, TREASURY.

(plates III and IV).[1] Nevertheless there can be no doubt that the vault belongs to the original building, and that the whole forms one work.

The half-shafts to the supports in the middle of each side of the room have bases moulded with a hollow above a torus. Their capitals (plate V) vary, one having scallops of advanced type, and the others have leaves or scrolls, heads, and beasts. Their abaci show a flat face above a quirk and a hollow chamfer, and these are continued as imposts around the pilasters on each side, and around the pilasters in the angles of the room. The wall-arches which spring from these pilasters, two on each side of the room, enclose on the north and south sides the recesses of varying depth already mentioned; on the east and west sides, each of the wall-arches encloses a semicircular arched window, with a lower semicircular arched cupboard on each side, except that in the southern bay on the west side there is no cupboard recess on the north side of the window. Externally the windows are included within the central arch of a triple wall-arcade in each bay, and above this a richly ornamented intersecting wall-arcade of less height masks the wall at the level of the vault.

The vault is octopartite (plates III and IV) with ogives springing from the angles, and doubleaux springing from the middle of each side. Its geometrical structure follows the system already discussed, but with some noteworthy modifications.

The height from the springing (top of abaci of supports) to the underside of the key averages[2] about 10 feet 11 inches. The spans of the doubleaux are 21 feet 10 inches (east to west) and 22 feet 1 inch (north to south). Although the height is thus about half the span, the doubleaux do not follow a complete semicircular curve, but they are stilted to some extent, horse-shoe fashion, above the springing. It would seem that each half of the doubleau is a quadrant of a circle, the two centres of the curves being spaced apart to the extent of about the width of the doubleau itself.

[1] I have to thank my friend, Mr. J. V. Saunders, M.A., for his kindness in taking specially for me the photographs reproduced in plates IV and V.

[2] There is an extreme variation of some 5 inches in the heights from the floor to the tops of the abaci or imposts of the supports.

The spans of the ogives are 32 feet 1 inch (north-east to south-west) and 32 feet 4 inches (north-west to south-east), and they rise, of course, to the same height as the doubleaux. If, as in the earlier examples, their curves had been simple arcs of circles, they would have been much depressed, and they would have sprung from the supports at a very awkward and ugly angle. This was avoided by the adoption of a composite curve, apparently struck from three centres, a curve of long radius for the central part, continued to the springing by two curves of much shorter radius, struck from centres on or near the springing-line.[1]

As the supports in the middle of the north and south sides are wider than those of the east and west, the spans of the east and west wall-arches are wider than those on the north and south sides Their height being the same, the east and west arches are practically semicircular, while those on the north and south sides are stilted horse-shoe fashion.[2]

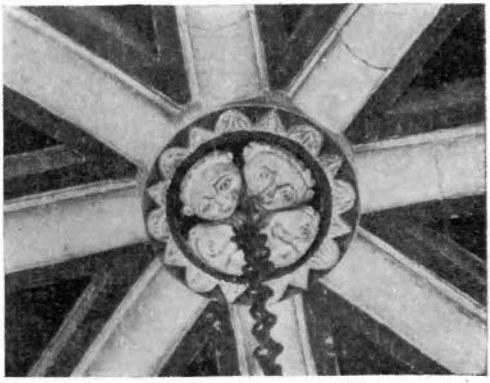
As a result of this system of curves, the crowns of the wall-ribs are (on the average) 5 feet 8 inches below the crowns of the cells at the key. The cells are constructed something after the fashion of triangular sections of a ramping barrel vault, generated by the semicircular curve of the wall rib, but with an important difference. In all the earlier vaults of the Norman school that I have noticed, the cells have been built on straight centering, and consequently are concave only in one direction, and their section at the crown would give a straight line. Here, however, the cells are concave in both directions, and the section of their crown shows an arched line (section at A B on plate III). The cells are plastered on the underside, and, as the top of the vault is covered by a floor, it is not possible to see how the courses of the cells are built.

The doubleaux and ogives are each 10½ inches in width, and are built of shallow voussoirs, averaging about 6 inches in height. They are moulded alike with a roll flanked with a small fillet and a broad flat face (fig. 1, no. vi). This profile is found in some of the smaller vaults of the Caen group.[3] The key is shouldered for the eight ribs, and is

[1] In plate III, the dotted centre lines of the doubleaux and ogives on the plan represent the springing-lines on which the curves of each are set up.

[2] See the elevations on plate III.

[3] Bernieres-sur-Mer (fig. 1, no. vii) and Ouistreham (Calvados), ogives of aisles of nave; Clinchamps (Calvados), choir, doubleaux and ogives; Petit-Quevilly (Seine-Inferieure), ogive of choir.



CANTERBURY, DETAILS OF TREASURY.

From photographs by Mr. J. V. Saunders.

ornamented with a circle covering the intersection of the rolls, which contains four heads, within a border of small semicircles and triangles alternately, containing small leaf ornament (plate v).

The wall-arches are 8 inches wide on the face, and are surrounded by a wall rib, 5 inches wide, chamfered on the lower edge, and with a small chamfer on the upper edge.

Comparing this vault with that of the crossing of Montivilliers, it may be observed that, while the general system is the same, there are some noteworthy differences. At Montivilliers the pronounced stilt of the doubleaux gives a greater proportionate height to the ogive, the segmental curve of which thus approximates more nearly to a semicircle than would have been possible at Canterbury if a single arc of a circle had been adopted for the ogive. In this respect Canterbury adheres more closely to the earliest practice, but the composite curve adopted for the ogive is a distinct advance. Two other points in which the Canterbury vault is more advanced than that of Montivilliers are the adoption of wall-ribs, and the concavity of the cells in both directions.

The date of the Treasury and its vault can be fixed with some approximation to certainty. Its details, though of the same rich Romanesque type, are finer and more advanced than anything in Ernulf and Conrad's eastern arm, even than its latest parts, the upper stages of St. Andrew's and St. Anselm's towers, though we cannot be certain that these were finished before the consecration of 1130.[1] However, the ground story of the Lavatory tower[2] affords a more precise index of date. Some details of the Treasury are found also in the Lavatory tower, which indicate that there cannot be any great difference of date between them. But some other details of the Lavatory tower are in advance of anything to be seen in the Treasury; e.g. the ornaments on some of the abaci, the leaf ornament in some of the little spandrels of the chevrons to the arches of the octagon, and especially the 'dog-tooth' ornament in the hood-mould of the outer

[1] Prof. Willis (*Monastery of Christ Church*, p. 75) thought that the Treasury 'must have been undertaken as soon as possible after the enlargement of the church was completed, probably after its dedication, which took place in 1130.' I think, however, that its date must be put somewhat later than he seems to suggest here.

[2] Willis, *Monastery of Christ Church*, p. 51, and plan, fig. 5.

arches. These prove that the Treasury was built a little before the ground story of the Lavatory tower, and the date of the latter can be very closely fixed. Both buildings are shown on the well-known 'Norman drawing'[1] which illustrates the system of water-supply devised and carried out by prior Wibert (1153–1167).[2] The Lavatory tower belongs to this hydraulic system, and was therefore executed about 1160.[3] There is therefore ample ground for believing that the Treasury cannot be earlier than about 1150, and that its building must be attributed to c. 1150–1155.

IV. CONCLUSION.

These two vaults of Montivilliers and Canterbury are important because they show how the system of the ribbed vault, introduced in the Norman school towards the end of the eleventh century, had been continued and developed by the middle of the twelfth century. Both vaults are, in their system of construction and decoration, purely Norman, and owe nothing to any outside influence, and every stage of the development which led up to them can be followed in the orderly sequence of the examples which have survived.

They are, however, especially important from a wider point of view. They show precisely how far the Norman school had advanced in vault construction before the architecture of their respective districts[4] shows any indications of influence from the school of the Ile-de-France. They represent, so to speak, the last word in vault construction with the semicircular arch alone, before the adoption of the pointed arch removed many difficulties.

[1] Reproduced by Willis, *ibid.* pl. 1, part 2.

[2] *Ibid.* p. 4, where Willis attributes the drawing to c. 1165.

[3] *Ibid.* p. 51.

[4] I do not intend here to assert that, by the time that the Treasury of Canterbury was built, there are no indications that French influence had not then begun to touch English architecture. Possibly some early Cistercian building might be quoted as proving the contrary. It is certain, however, that there is extremely little in England which points in this direction which can be attributed with any probability to any date before the accession of Henry II (1154), and certainly there is nothing at Canterbury. Indeed the stage of architectural development which the school of the Ile-de-France had then reached makes it improbable that it could have exerted much influence in England before this time.

This point can be best illustrated from upper Normandy, where, naturally enough, influence from the Ile-de-France can be recognized much earlier than further west,[1] and where, again quite naturally, the development was more logical and regular than it was in England. Fortunately an excellent example, very much to the point, is to be found in the Tour Saint-Romain at Rouen, that admirable tower which rises to the north of the west front of the cathedral.[2] Its two lower stories are covered by octopartite vaults, which it will be useful to consider, by way of comparison with the two vaults which have been described above. By the side of these we may place the contemporary chapel of Petit-Quevilly, just outside Rouen, which there is reason to believe was founded by Henry II about 1161.[3]

In the ground story of the Tour Saint-Romain,[4] each of the eight ribs of the vault is received by a large single attached shaft; those under the doubleaux are pointed (or keel-shaped); those under the ogives have a broad fillet on the face, and their capitals and bases are set diagonally, in the direction of the ogives. Both doubleaux and ogives are pointed, springing from capitals at the same level, and rising to a common key. The curves of the doubleaux are stilted considerably, and those of the ogives seem to be struck from centres on the springing-line. The geometrical system is therefore controlled by the curves of the ogives. The lunettes of the vault form pointed arch curves, stilted far above the springing, and there are no wall-ribs. The cells are constructed

[1] The district of Caen, with its powerful architectural traditions and fine building-stone, seems to have received the new influences later, not only than upper Normandy, but than most districts of England. Normandy in general affords an example of a phenomenon which is not rare in the history of mediaeval architecture; a school which has achieved great things continues its old traditions, and allows itself to be passed in the race by a school which was less hampered by its relatively smaller past achievement. This is especially true of lower Normandy.

[2] For the external elevation of the Tour Saint-Romain, see Viollet-le-Duc, *Dictionnaire*, iii, 370, fig. 62, and a better drawing in R. J. Johnson, *Specimens of Early French Architecture*, pl. 11.

[3] *Chronique de Robert de Torigni*, ed. Léopold Delisle (Rouen, 1872; Societe de l'histoire de Normandie), i, 331. 1161, 'Henricus rex . . . ; parcum et mansionem regiam fecit circa fustes plantatos apud Chivilleium, juxta Rothomagum.' Although the chapel is not mentioned here, its foundation may almost certainly be attributed to this date, with which its architectural character entirely agrees.

[4] For section of the two lower stories of the tower, see M. Chaine's drawing reproduced in A. Loisel, *La Cathedrale de Rouen*, p. 71 (series of *Petites Monographies des grands edifices de la France*).

of dressed stone for a considerable height above the springing, and above this they are of coursed rubble, covered with plaster. The crowns of the cells rise considerably from the walls to the key. The doubleaux and ogives are profiled alike, with a roll between two hollows (fig. 1, ix), which, in its essence is the profile of the ogives of the earliest dated ribbed vaults of the Norman school, those over the choir aisles of Durham cathedral; here, however, the roll is pointed (or keel-shaped).

The octopartite form of this vault does not seem to me to be derived from the Ile-de-France, where I know of no earlier examples which could be supposed to have influenced it. It must rather be considered as a development from such a vault as that of the crossing of Montivilliers, improved by the adoption of the pointed arch for all its curves. This important advance must be attributed to French influence, for the systematic adoption of the pointed arch in rib-vaulted construction was the achievement of the school of the Ile-de-France, and only spread later to Normandy and England. The dressed stonework of the lower part of the cells is French rather than Norman, and the same may be said of some of the profiles. The keeled form in the shafts and ribs was in general use earlier in the Ile-de-France than in Normandy or England.[1] On the other hand, we find an advanced variety of the scalloped capital which is purely Norman, as also is the characteristic capital with angle volutes over a row of leaves, here with the broad fillet continued through the capital into a sort of console between the volutes. Even in the capitals, however, we find the flat leaf which seems to be French rather than Norman.

This lower story, therefore, shows a mixture of French and Norman influences, such as might result from Norman craftsmen working under the general direction of a master who was either of the Ile-de-France, or had previously worked there.

On the other hand, the system of the sexpartite vault of the choir of the chapel of Petit-Quevilly[2] continues the Norman tradition. The central doubleau is a stilted

[1] *Archaeological Journal*, lxvi, 262.

[2] For descriptions of Petit-Quevilly, see Dr. Coutan's article in *La Normandie monumentale et pittoresque* (1893), i, 239, and the same author's article in *Le Millénaire de la Normandie*, 189 (1913).

semicircle, and the ogives are segments of circles, only slightly less than semicircles. The crowns of the lateral cells rise considerably from the walls to the key of the ogives, and these cells, at their junction with the walls, form a semicircle considerably stilted, without wall-rib. The capitals of the shafts under the ogives are set diagonally. The profile of the ogive is the same as in the Treasury of Canterbury (fig. 1, vi), and that of the central doubleau is a filleted roll flanked by a hollow on each side; but in the ribs of the semi-dome of the apse, and in the arches elsewhere, we find the pointed roll. The system of the choir vault is the same as that of the crossing of Montivilliers, but the details are more advanced. The system is less advanced than that of the vault of the ground story of the Tour Saint-Romain, and there are no pointed arches here. As to the details, the profiles of abaci and bases are similar to those in the ground story of the tower, and, although the chevron and other Norman motives are retained, the character of some of the other details is slightly more advanced than anything there. All, however, are less advanced than the first-floor of the tower.

My conclusion is that the chapel was begun after the ground-story of the Tour Saint-Romain, and was built under the direction of a Norman master, who was influenced to some extent by the French characteristics of the nearly contemporary work of the tower. As the chapel seems to have been founded about 1161, we may place its building within the decade 1161–1170. The ground-story of the tower cannot, I think, have been begun before 1150, and we may reasonably place its beginning somewhere between 1150 and 1160.[1]

The first-floor of the Tour Saint-Romain,[2] although it doubtless closely followed the ground-story, was evidently built by another master, for its characteristics (except perhaps the general idea of its octopartite vault) are entirely those of the school of the Ile-de-France. The supports

[1] These conclusions differ slightly from those of M. Albert Rieder, in his paper, *De la Tour Saint-Romain a la Cathedrale*, in the *Bulletin de la Societe des Amis des Monuments rouennais*, 1908, pp. 97–107. His suggested date of about 1170 seems to me to be quite sufficiently late for the first-floor of the tower.

[2] For plan, see A. Loisel, *La Cathedrale de Rouen*, p. 70.

which receive the ribs of the vault are here, as in the story below, a large shaft in each angle[1] and in the middle of each side (here not keeled nor filleted), but these are flanked by smaller attached shafts with capitals at the same level, from which rise the shafts which receive the wall-ribs. The geometrical system of the vault is the same as that of the story below, with pointed doubleaux and ogives, and here, in addition, pointed wall-ribs. The cells are constructed in the same manner, and their crowns rise from the walls to the central key. The doubleaux and ogives are profiled alike, with three rolls, the middle roll being larger and keel-shaped (fig. 1, x). The profiles of the abaci and bases, and the sculpture of the capitals and hood-moulds are similar to contemporary work in the Ile-de-France.[2]

Canterbury tells the same story. Although the work of William of Sens shows, in some minor respects, traces of Norman tradition and influence,[3] its characteristics are almost entirely French,[4] and differ widely from the purely Norman work of the Treasury.

These considerations amply confirm what has been said above, that the octopartite vaults of the crossing of Montivilliers and of the Treasury of Canterbury are purely Norman, and owe nothing to any outside influence. When influence from the Ile-de-France does indeed arrive in these districts, it is perfectly easy to recognize it—as in Normandy, in the Tour Saint-Romain, in the chapter-house of Saint-Georges-de-Boscherville, and to a less extent at Petit-Quevilly; and in England, in the work of William of Sens at Canterbury.

We may therefore regard as completely disproved the

[1] Those who are inclined to exaggerate the importance of the plan of supports in these early examples, in which the builders were gradually evolving the logical Gothic system, should note that, whereas in the (earlier) lower story the capitals and bases of the angle shafts are set diagonally, those of the (later) first-floor are set square.

[2] Cf. Saint-Evremond, Creil; R. J. Johnson, *Specimens of Early French Architecture*, pls. 5 and 6; Eugene Lefevre-Pontalis, *Saint-Evremond de Creil: notice necrologique*, in the *Bulletin Monumental*, lxviii (1904), 160. This church was wickedly demolished in 1903, under the deplorable influences which have been eloquently pilloried by M. Maurice Barres in *La grande pitie des eglises de France*.

[3] See Prof. C. H. Moore's analysis in his *Mediaeval Church Architecture of England*, pp. 73 ff.

[4] It is very generally assumed that William of Sens was the master to whom the design of Sens cathedral was due, but there is no proof of this, and it scarcely seems to me to be confirmed by a comparison of the two buildings. There can be little doubt, however, that William had worked on the cathedral of Sens.

theory, which not long since was favoured in France, that the Normans derived the ribbed vault from the Ile-de-France. On the contrary, the earlier examples in Normandy and England show a regular sequence of development extending over half a century before either country comes under any influence from the Ile-de-France at all. The earliest examples of which the dates are certain show that the innovation began in the Norman school at least as far back as the last decade of the eleventh century. The oldest Norman ribbed vaults show rudimentary characteristics and system which are scarcely represented at all in the earliest examples in the Ile-de-France. The conclusion is irresistible, that the early Gothic school of the Ile-de-France was indebted in no small degree to what had already been done by the Norman school, and that its rapid advance was only possible because it was not hampered by any settled traditions, and was therefore able to profit to the full by the earlier Norman achievement.