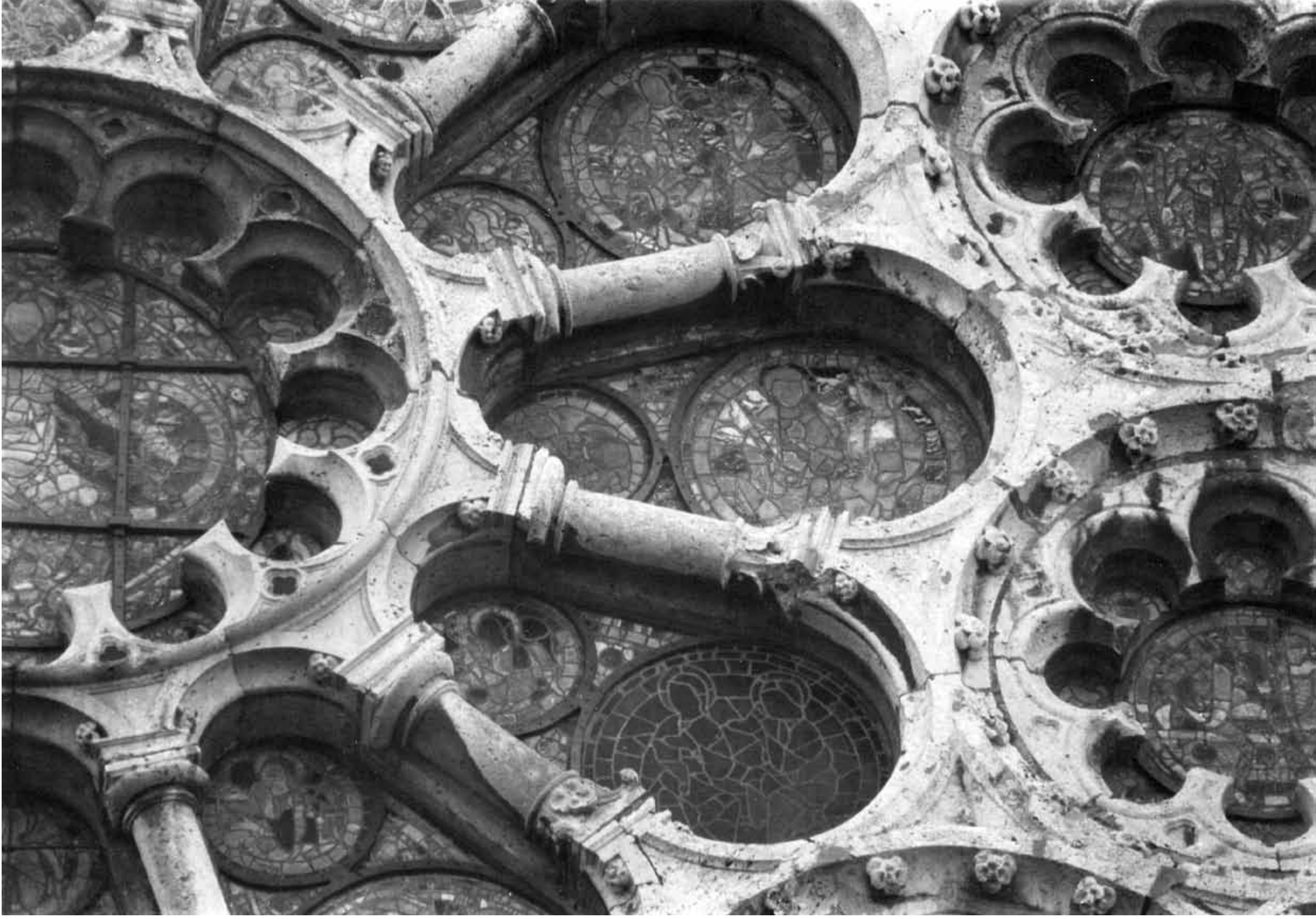
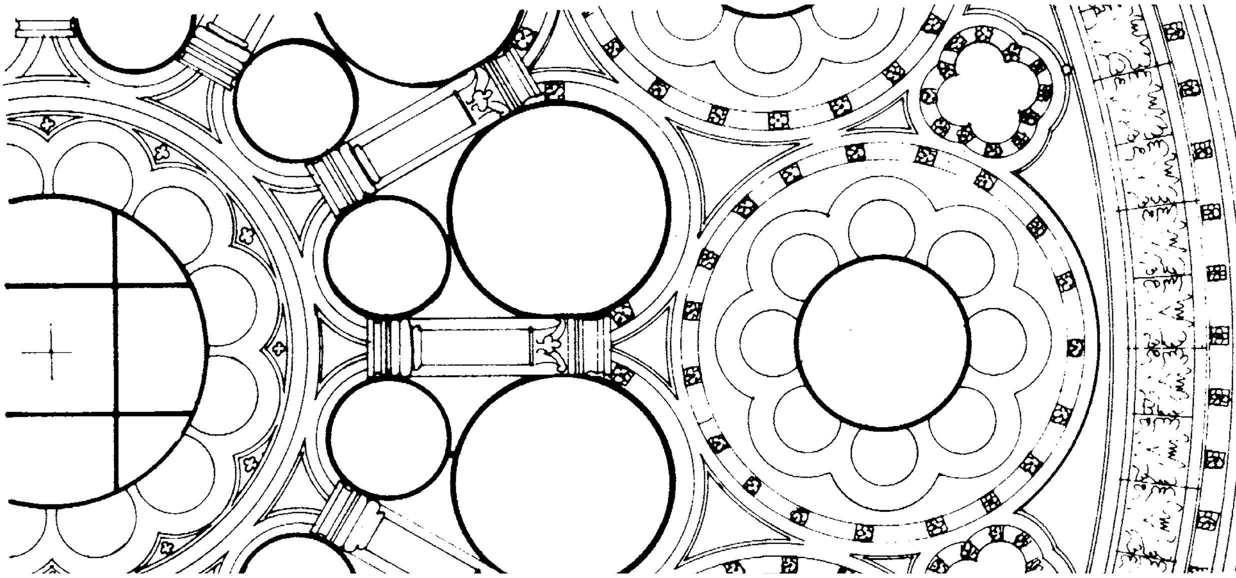


The western rose of Chartres cathedral

Adapted from *Architectural Association Quarterly*, v 1973, 4-10

The stonework of the great western rose hangs in splendour over the main entrance to the cathedral. No book on Gothic architecture is complete without a photograph of it – mute recognition of the fact that it, and its flanking towers, symbolise Chartres to the world. Many have studied the art and meaning of the sculpture below the rose and the two towers on either side, but the spiritual heart of the cathedral façade remains unknown. It is the rose that centres the eye, calming the elements around itself so that all move as one. Remove it from the photographs and the symbol disintegrates. As the crown is to the throne, so the rose is to the cathedral. It is a perfect unblemished whole, which is why we may have accepted its truth without seeking the cause.

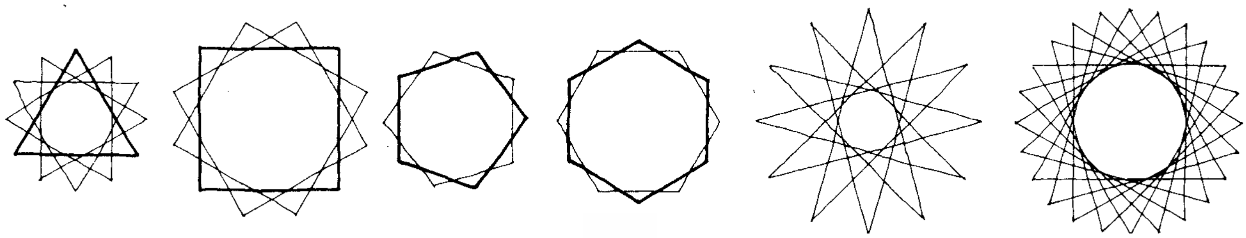
The drawing de Lassus made of it in the 1840's gives enough information for a detailed study (*Monographie de la cathedral de Chartres,* 1842), which I have supplemented with measurements taken in 1968 by Henri Dubarge, the cathedral Guardian, and a measured drawing kindly given me by M. Dorian the cathedral architect. From their dimensions I have drawn the 'ideal'



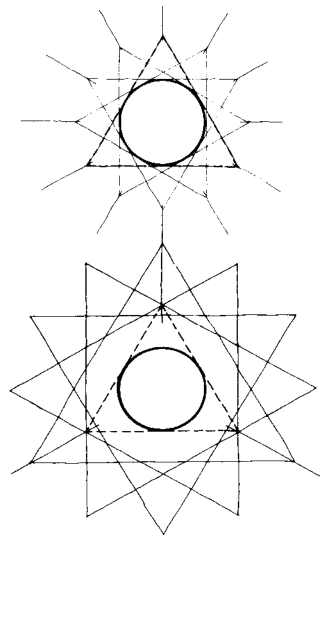
window, as one presumes it would have been before settlement, weathering, repairs and errors during erection took their toll. The figure above shows one segment.

The geometry that emerged from this drawing is so neat in all particulars that I believe it to be correct. It is a marvellous and fascinating *tour de force* where five separate systems of proportion rhythmically pulse across the wheel, dividing the whorls from the vortex.

There is a triangle, a square, a pentagon and hexagon, and a number of twelve and twenty-four pointed stars. They all seem to have been applied in this natural order. There is an octagon that grows into eight points repeated three times to form a magnificent jewel coruscating through its eyes. The final figure is an endless twelve-pointed star, where you can travel along each line without once repeating yourself until you finally return to the beginning [b].

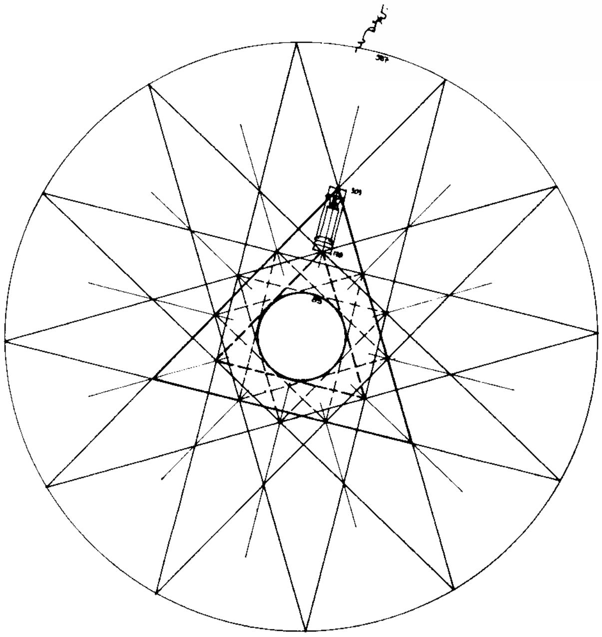


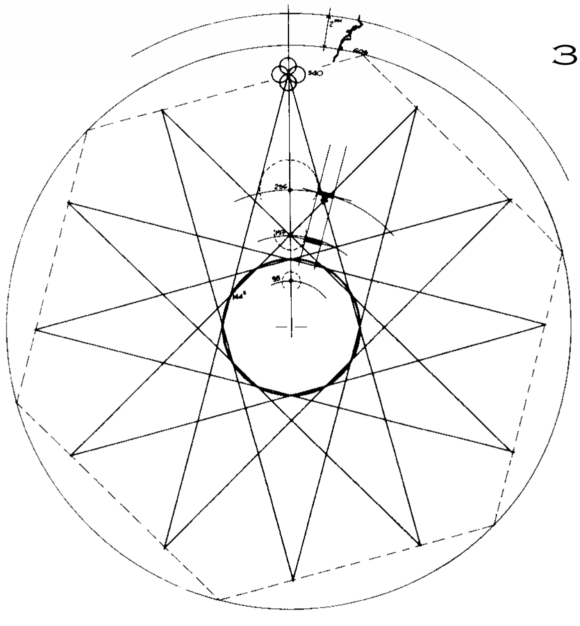
These figures are not just superimposed on one another in a haphazard way. No, they grow logically from two origins. One group forms a sequence of triangle-square-pentagon (using ratios of 3:4:5) with their attendant stars, and the other of hexagon-dodecagon (ratios 6:12) also culminating in stars. The choices, the origins and growth are guided by an orderly rational hand.



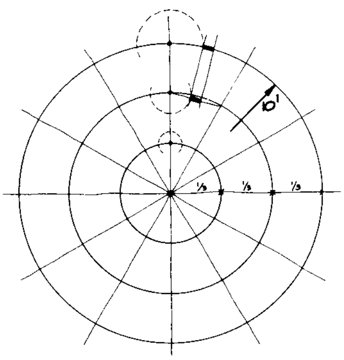
One group expands from a unit of 3 foot, and the other from its inverse expressed as reducing thirds. Three in counterpoint to thirds in a marriage of opposites. The 3 foot unit multiplies as it doubles and doubles to 6 foot and 12 foot. The thirds divides as it contracts from a 10 foot circle to ⅔ and ⅓. From these two grow each of the first four basic figures in its geometry that culminate in a cunning reconciliation of the irreconcilable.

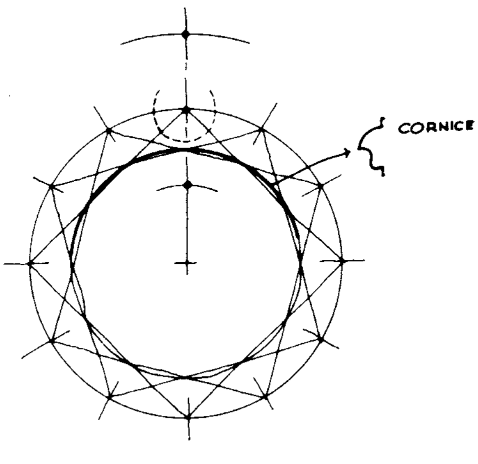
Around the three foot unit the Master drew a three sided figure four times [r1], and around each pair of these another set of three triangles [r2]. From the first step he fixed the inside moulding of the central circles, the ends of the columns, and by spreading it into a star, fixed the inside moulding of the frame that runs around the rose [top left, next page].

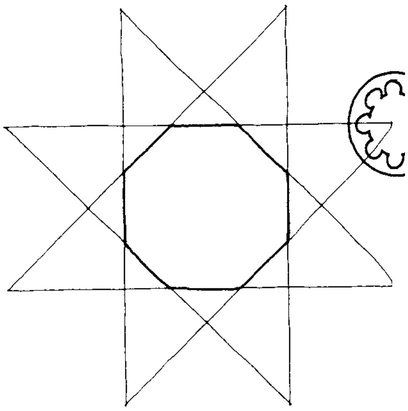




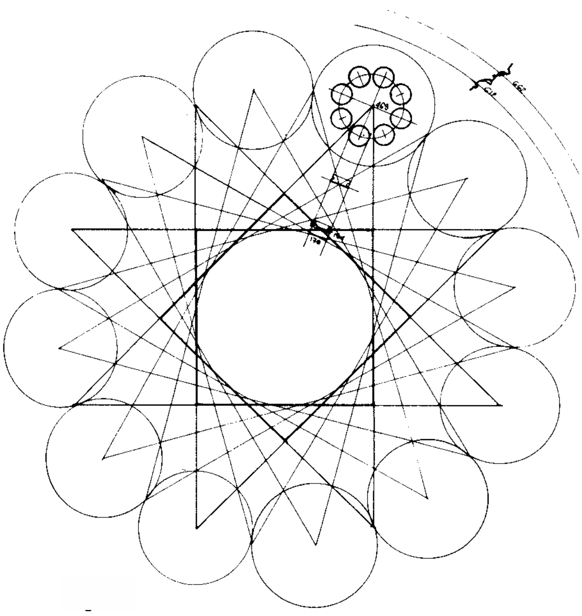
In the next operation he worked from thirds, and by rule and compass positioned the centres of the three inner rows of circles [b2], from which he fixed the masonry joints in the columns (next page). He then drew three squares from the middle row. Where the sides crossed one another, he fixed the powerful projecting cornice that surrounds the inner light [a2]. He expanded the same squares into a star [b3], to determine the centres of the small four-leafed openings around the perimeter [a2]. With an elegant precision the master placed the leaf that adorns the centre of each capital on the intersection of the arms of the star. Thus, in a splendid consistency the thirds fix both leaf forms, and the three concentric rings of the circlets that look like a sunflower.

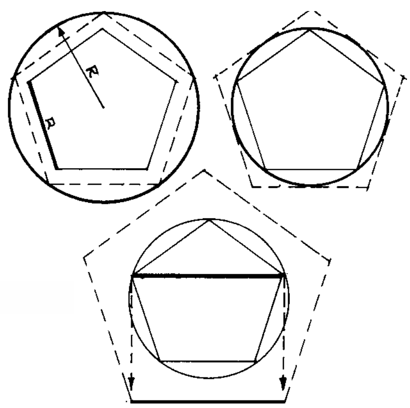






Appropriately, the hexagon surrounding this figure determines the inside of the frame of profuse curled leaves that rings the whole creation. Perhaps it reminded him of a flower, its petals, the surrounding foliage. Returning to the 3 foot unit, he moved from triangles to the next basic geometric figure, the square. Two squares of 12 foot each set at 45° will produce an octagon which can be enlarged to a star, which will fix the outer ring of twelve circles [r3]. Again, with an appropriate gesture, he lay only eight lobes around each of these outer circles, rather than repeat the twelves found in the rest of the work. An eight-leaved jewel to reflect the octagon it cam from. A unity of number and geometry. The square surrounding this star fixes the inside of the leaves around the rose, while the next outside square set true to the radius fixes the encircling ring of rosettes.





As in the earlier groups this arrangement is repeated three times to pick up the centres of all twelve circles. Its intersections coincide [r1], with the bottom of the torus mould underneath the columns, and with the top moulding of the crocketed capitals. Also, it almost meets the centres of the two rows of circles in the lozenge. They miss one another by about 25 mm, yet are still close enough to suggest a happy link with the series of thirds. However, the two series are more intimately bound together in two other places: at the projecting cornice which encircles the inside light, and at the outside cornice which rings the whole rose. The dominance of these mouldings in the pattern of the rose is explained by their role as binders to hold the two major systems together.

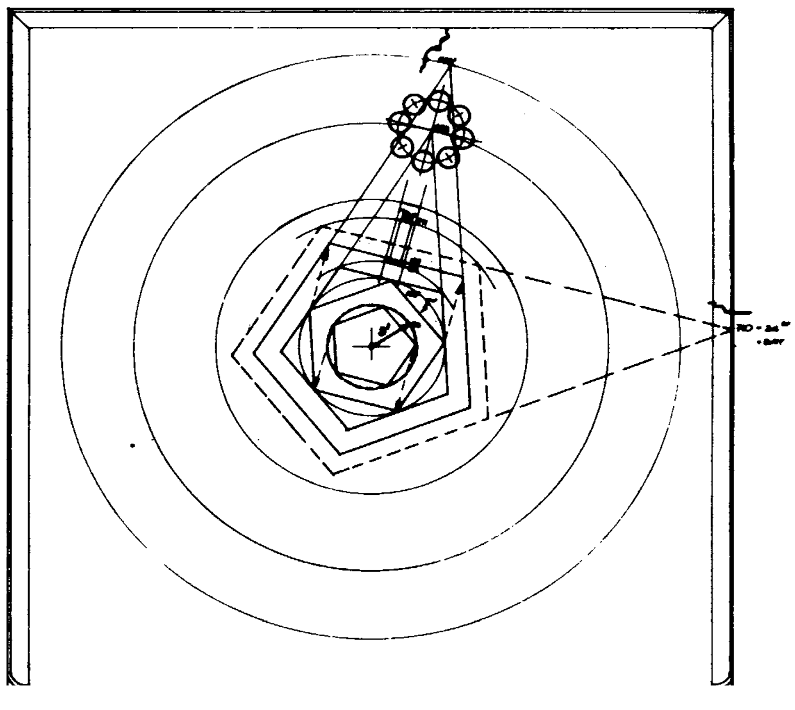
To achieve this, he returned once more – a third time! – to the 3 foot unit, and drew a pentagon within the central light. From this he formed a number of others in the steps shown in [r2]. You can see in [r4] how many of the more important points already determined by earlier figures are confirmed by the pentagonal series. An amazing *tour de force* – to be able to bind together so many unrelated parts into the pentagonal figures. It is possible, though I don't have the measurements exactly, that the star from the largest of them picks up the outside square frame surrounding the rose itself. In this frame the Master related the rose to the rest of the building, for the distance from the centre of the rose to the edge of the frame is the same as the spacing of the piers down the nave. The bay width inside is here reflected on the outside. It measures 24 feet and thus reflects the number of segments in the rose.

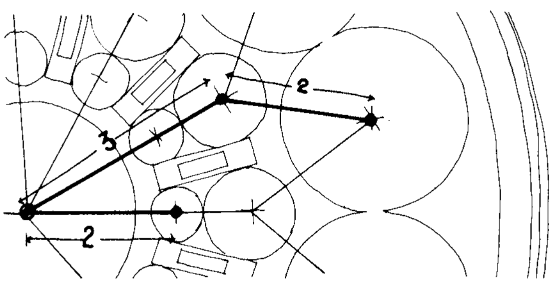
We cannot be sure that the pentagon was only a secondary figure used to reconcile the differences between the others, and not the primary figure. The other geometric figures betray a consistent evolution using nothing but factors of 3's and 4's that it is hard to see the pentagon as primary. It may be primary in the rose at Amiens, for example, where a five- pointed star sits in the centre of the rose, but the twelve-sided nature of Chartres suggests that my interpretation is correct.

When medieval masons conjoined more than one system together like this, they were careful to find the points that linked them and in spite of each having its own role, each would vibrate within fixed frames. The frames acted like nodes through which each system passed. They were appeared emphasised, like a standing wave raised higher than its fellows by the coincidence of a number of different vibrations.

In this rose the two frames are those two cornices through which both systems of threes and thirds are linked to one another through the pentagons. The cornice round the inner light finishes in a sharp projecting edge, thrusting forward more than any of its neighbours. The other cornice surrounding the rose also projects, and is encased in massive leaves.

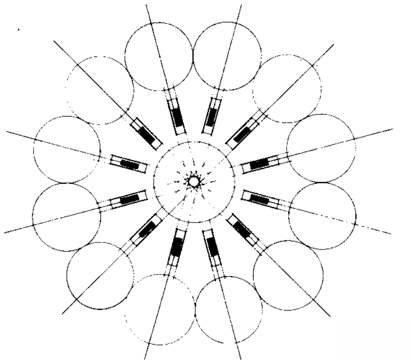
Besides the pentagonal series which links the threes and thirds there is another linkage which may have formed part of the initial design. It binds the three rows of circles from the thirds with the outer circles from the octagons by a neat little figure. The distance from the centre to the outer



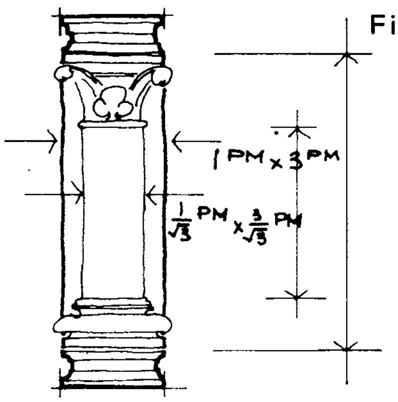


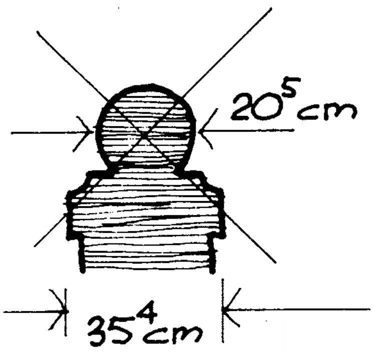
third is 10 feet [r1], while the distance from here to the centre of the outside circle is two-thirds of this; equal to that from the centre to the middle circle. It makes a pretty triangular pattern made up of regular modules.

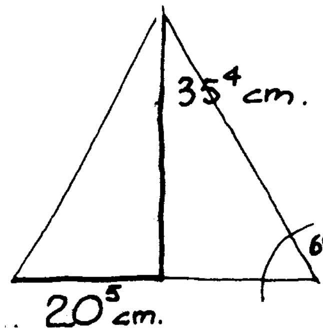
The foot unit used is the Roman Foot of 296 mm. As we have seen, it determines the centres of all the major circles, the outline of the columns and the surrounding frames. But this Master uses a second unit as well: the Ped Manualis of 354 mm, which is 6/5ths of the Roman Foot. It determines the size of many of the small circles surrounding the others, we well as the columns. These are like a series of spokes [r2], radiating from the centre, each one PM wide. The length of the piece of stone that makes up most of the column between the joints is exactly 3PM. Yet you will remember that these joints had already been fixed from the figure of thirds, which was derived from the Roman Foot.

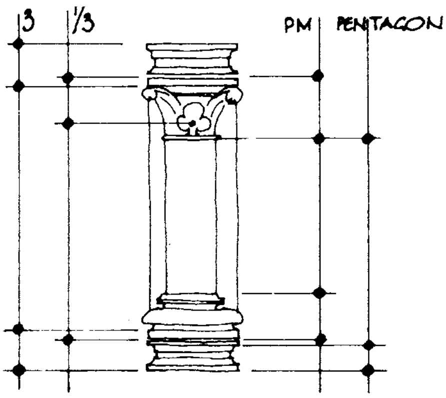


It is curiosities like this that make medieval geometry such a delight. Intended? Accidental? Who knows, but it may have thrilled its creator. For it gave him a proportion of 3:1 between the length and width of the stone. The same ubiquitous ratio is repeated in the shaft of the column between the base and cap [b1], which forms 3:1, while the diameter of the column compared to the width of the stone behind it is 1:√3, or two of the sides of an equilateral triangle [b2] and [r3].

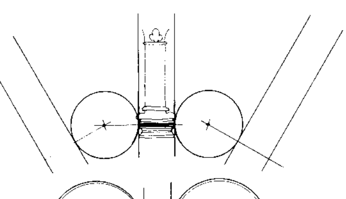


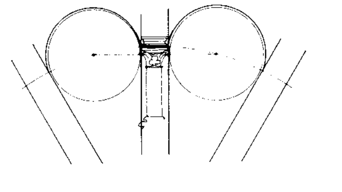






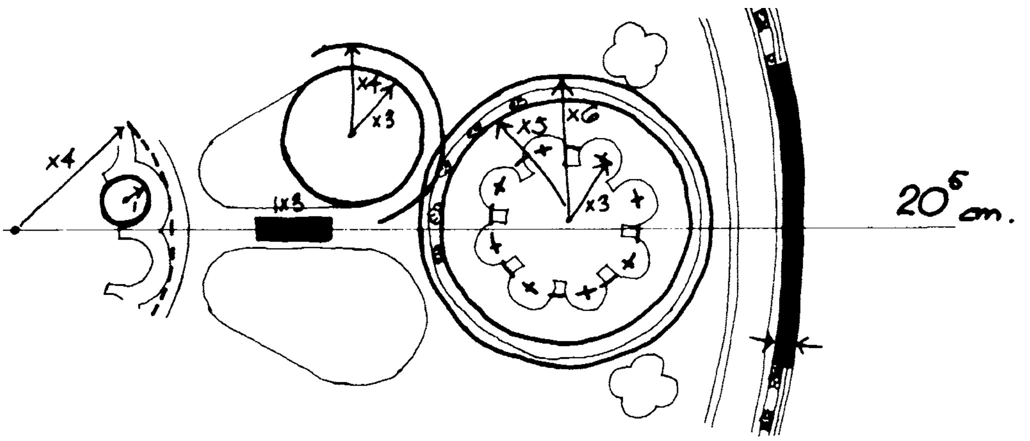
As you can see in [r4] all the major elements in the column-spokes have by now been determined by one or other of the basic figures. Once you superimpose these spokes onto the earlier geometry the diameter of the bottom circle of the lozenge is automatically fixed by the space left between the sides of the columns. This should also apply to the upper circle, but does not. The upper one's diameter is a little large, for the master had a problem: either to make the radius fit between the column spokes, or to let it marry with the frames to the outer circles. Perfection in the minutiae of a complex geometry is not possible. He had to make a choice where neither solution would be totally satisfactory. We have already seen how the octagon that fixed the outer circle missed those in the lozenge by less than 30 mm. If he had stretched the whole rose, so that the diameter of the outer frame was increased from 13,600 mm to 13,710 mm these two discrepancies would not have occurred. But then the square frame would no longer have reflected the bay centres inside, nor would he have maintained the same neat conjunctions with the pentagons.





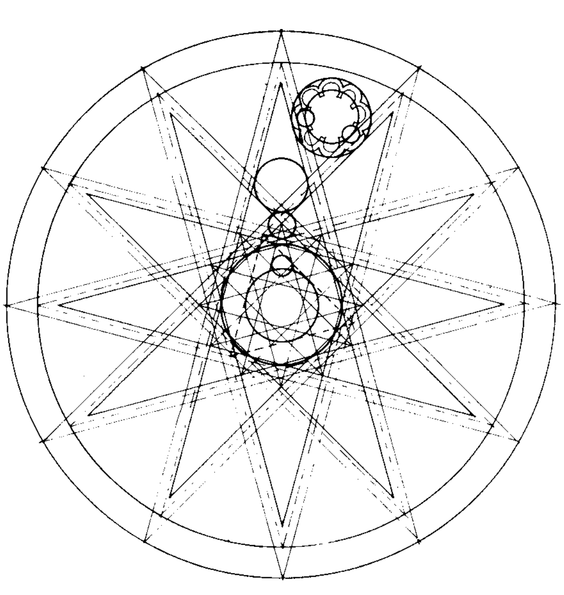
He made his choice, and modified the junction between the outer circle in the lozenge and the columns to, as it were, re-establish harmony. To see what he did, let us first examine the junction at the bottom of the column, upper part [r5]. The joint in the masonry lies on the line joining the centres of the adjoining circles, so that the inner stone forms the entire curve, while the outer has straight sides from the joint outwards – logical and easy to cut. The outer joint, on the other hand, lower part, lies on the arc from the centre of the rose through the centres of the outer lozenge circles.

This increased the length of the column stone to the 3PM he sought, and at the same time the circles, being larger than the space between the columns, met the sides of the column higher up so he was still able to cut the arches from one stone, and leave the column block with straight sides. A neat solution that did not disturb any of the primary geometric figures, while adding richness to the design. For the outer column-circle was now equal to those in the outer circles, and to the twelve lobes round the central light, to the projecting cornice we have met so often before, and to the width of the encircling band of rosettes [b]. It is also three times the drum of the column.



Similarly, the Ped Manualis is repeated in the outside of the lozenge arch moulding, and the band of leaves round the rose is 1 PM thick, while the entire encircling frame measures 2 PM, and projects 1 RF in front of the rose face. The RF is itself repeated in the latter's lobes.

Thus, the two foot units flow over andunder one another as they separately determine their own parts of the rose. They are summarised around the outside where the four-leaf lights use the RF and the eight-leaf outer circles use the PM. Without continuing to belabour each detail, every minor element and every moulding reflects one or other of the basic measures. In careful geometry everything is made a part of everything else; nothing stands alone.



Thus, it was with God's Universe, thus it should be in man's efforts in praise of Him. In confirmation of this all-embracing harmony, when we draw each of the circles we have discussed within the exploding stars formed from the first figures, not only are they fixed and sized as I have described, but in [r] they fit perfectly, tangentially between the arms of the stars! So what determined the sixes of these circles? Which came first? First class geometry produces such an integral amalgam that we cannot be sure.

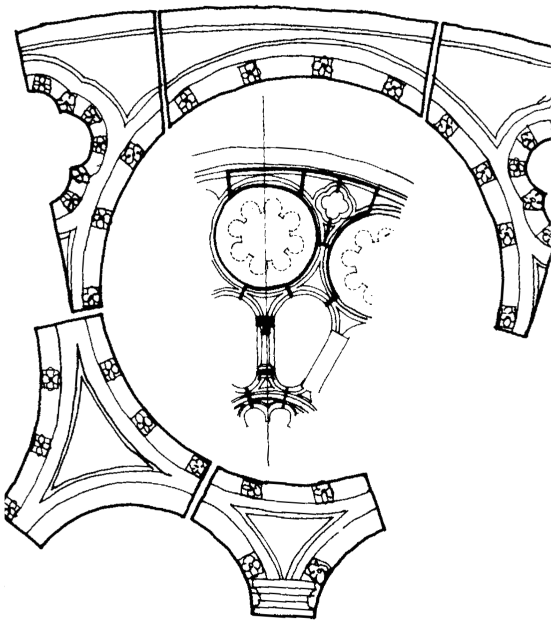
But we have not finished yet. Geometry is not the only expression of this great architect's genius. Numbers had an intrinsic significance and medieval ideas were often reduced to numbers in a process called gematria. Each letter of the alphabet is given a number from 1 upwards, and these are totalled. The more significant words that make up a number, the more important that number becomes.

The rose has 37 openings. Not only is 37 a prime, but when multiplied by 3 (the original foot unit) gives 111. This links to a magic square. The square is a matrix of numbers that uses each number to 36 only once in such a way that they add to the same total along each row and across each diagonal. The sum of a 6x6 magic square is 111.

The surrounding cornice of the rose contains 74 leaves carved from 37 stones. Dividing a segment into 37 is not an easy task, especially when there are no geometric ways to do this. We must therefore conclude that it was worth the trouble and therefore that the number was in itself imprtant. There are 192 glazed circles, excluding the central one with the figure of Christ, which is one number of '*Mary'*. Thus, Mary the Mother, patron of the cathedral, enfolds her Son at the centre of the vortex just as she supports him at the apex of the central lancet window directly beneath the rose. Plato called 192 the *First of the Unities.*

Without going into its many mathematical meanings the ancients considered it very highly (William Symes Andrews, *Magic Squares and Cubes,* Chicago, 1908). So there are 192 lights, and also, when you count the number of rosettes surrounding the different circles there are twice 192, or 384! Once again, a number that is difficult to set out geometrically.

Each of the outer circles has 18 rosettes surrounding its one central circle and eight attendant lobes: or 1+8 = 9, or half of 18. The same argument runs for the four-leafed medallions, but with 12 rosettes to four circles. The eight stones used within the frame of the outer circles are like a sleeve within a ring. They were carved separately to their frame so they could be rotated to keep the eight leaves of the octagon constantly vertical. I do not doubt this was done to suit the glazier so he could place his figures vertically like the cars in a Ferris wheel. Such a device is an illustrator's, not a geometer's.



Lastly in numbers, each segment of the rose structure, excluding these rotating outer lobes, is built from exactly seven pieces of stone [b]. They are superbly cut from the hard Berchère limestone – a prefabricated job like the later English fan vaults where one template could be repeated and the parts assembled like a jigsaw. As we saw in the columns, the joints in the stonework are an important part of the design. They are neve placed accidentally, but with care for the best job, insert. They are so divided that the 18 rosettes comfortably fit between the joints in the pattern and mostly run true to their respective centres. The exception is the joint between the centres of the outer circles. It had to meet the vertical joint dividing the four-leaf medallions, and was therefore raised slightly to meet it at the bottom of the triangular recess between them. The adjustment is to carefully made that it does not disturb the rosette pattern, nor mislead the eye.

After studying this marvellous creation can we doubt that the medieval masters had as firm a hold on creative genius as the great of any other period? The finest works of man tolerate no accident; all is intended. Its total consistency is far from easy to design – just pause and think how you would approach such a problem! Then compare the western rose to the southern: to the explosive crystalline sun-star carved some ten years later. Much of the same geometry and number system applies, but in a more complex and ecstatic way. The west is more firmly rooted into its stone, more solid, less explosive – it is the natural form to face the dying sun. For the geometry of the noon-day rose we must wait.