229. Samuel van Hoogstraten, *Perspective Illusion*, 1662, Gloucestershire, Dyrham Park, the National Trust.

Like Aguilonius and his great Swedish contemporary, Schefferus, he is well aware that scenographic perspective is only a very limited case within the whole science of optical phenomena, but this does not lead him to suggest a fundamental revision to the available means at the painter's disposal.[72] Where he does show an individual flavour is in his wholehearted placing of illusion in the service of natural representation. His attention to light effects, which he discusses before he makes his brief comments on perspective, is consistent with this emphasis, and had been foreshadowed to some extent by Salomon de Caus's lively demonstrations of cast shadows in domestic interiors.[73]

The actual optical ideas in all the Dutch treatises were deeply conservative. Hoogstraten, like Marolois, still advocated an extramission theory of sight, and there is not the slightest glimpse of the new ideas on the mechanism of the eye pioneered by Kepler and extended by Descartes. Kepler's concept that 'vision is brought about by a picture of the thing seen being formed on the concave surface of the retina'—that 'the retina is painted with the coloured rays of visible things'—seems to offer a tempting parallel to the optical veracity of Dutch art.[74] Unfortunately, there is no evidence that such an identification was made. Indeed Kepler's theory on its own terms—set within his mathematical investigation of astronomical optics and placed in the service of his elaborately Platonising cosmology—offered the artist nothing new that he could immediately use.[75] Indeed, certain features of his theory, such as the 180° viewing angle, would simply have caused unwanted problems in an area which was already complicated enough.

The optical-perspectival features of Dutch art represent a complex alliance of traditionally Aristotelian optics, geometrical theory, standard workshop techniques and Eyckian naturalism with the empirical and applied tenor of Dutch thought at this time. The ingredients and proportions in this compound naturally differed for different artists, but there seems to be nothing in theory or in practice which cannot be encompassed by this interpretative model. There is much to be done in illustrating and refining this model—and we will ourselves be approaching it from a different angle in a later chapter—but I do not at present see any reason to look beyond it.

THE FRENCH PERSPECTIVE WARS

The matching span of fifty years or so in France from 1630, which saw the foundation of the most potent of all the early academies of art, may not unreasonably be considered as the golden age of the perspective treatise. It was certainly the prime period for vicious battles over questions of perspectival ethics. The disputes reached levels of personal bitterness which make the Bassi-Tibaldi altercation seem quite restrained. The story of these years, both as a human tale of factional rivalries within the artistic profession, and as an account of colliding aesthetic values, is not the first or last episode we are encountering in this study which is worth a book in itself. The sheer quantity of primary sources is formidable.

A list of the authors of the most significant treatises devoted specifically or substantially to perspective will give some idea of this abundance (the dates of the first editions of their main work or works are given in brackets): Vaulezard [1630], Desargues [1636], Niceron [1638 and 1646], Dubreuil [1642, 1647 and 1649], Aleaume and Mignon [1643] Bosse [1648, 1653, 1665, and 1667], Gaultier [1648], Le Bicheur [1660], Bourgoing [1661], Huret [1670], and Le Clerc [1682].[76] To this list need to be added the names of authors like Félibien who discussed perspective at greater or lesser length in more general books, of mathematicians who analysed pictorial perspective in their writings, and of foreign theorists like Marolois whose works were available in French. Not surprisingly, these treatises brought with them a great proliferation of constructional techniques. It is in the nature of perspective, for geometrical reasons that will become apparent when we look at Desargues, that the same result can be achieved in any number of geometrical ways. Many of the theorists in our list devised their own systems of varying degrees of ingenuity, practicability, complexity and obscurity. Not a few of them use geometrical devices which are remote—particularly from a painter's standpoint—from the optical realities of the original concept of seeing objects through the picture plane. The reader may be relieved to know that I do not intend to work laboriously through all the new variations.

The way I have chosen to approach this huge body of evidence is through the writings of Girard Desargues. I am doing this both because he was the greatest prespectivist and projective geometer of his generation, and because the arguments which raged around his system provide a good insight into the key issues with respect to art and science. Desargues was a civil and military engineer, an architect specialising in staircase design and above all a geometer of extraordinary spatial vision.[77] His intellectual ambition was expressed in two closely-related aspirations: the building of a geometry of position (i.e. non-metrical) based on projective techniques; and the provision of all-embracing methods of geometrical operation for practioners in various fields. He intended theory and practice to be integrated just as they had been for Stevin:

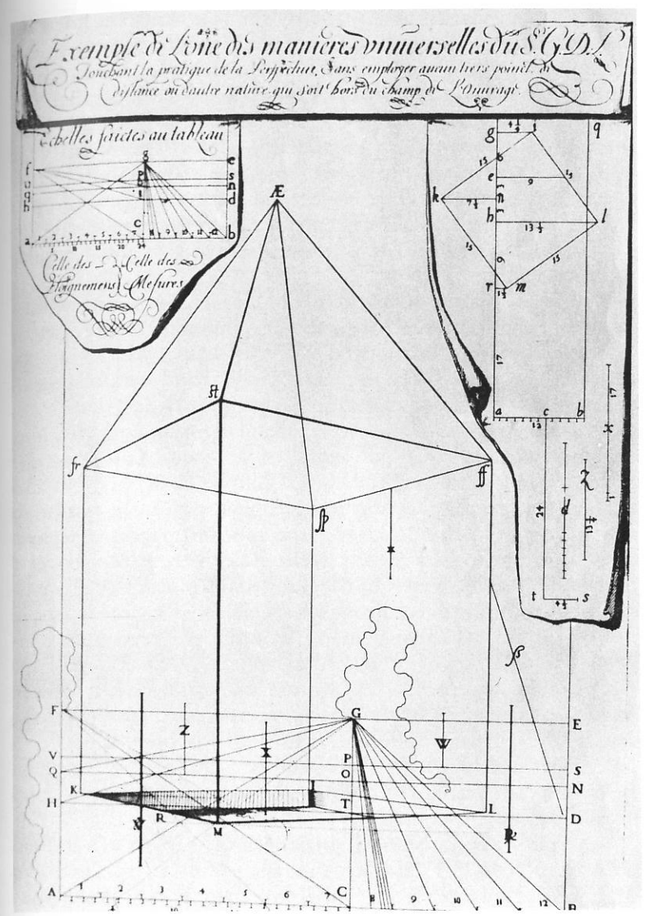
> I freely declare that I never had a taste for study and research in either physics or geometry except in so far as they could serve the fundamental purpose of arriving at a form of knowledge of proximate causes, . . . having observed that a large part of the practice of the arts is founded on geometry as the basis of certainty, amongst others the art of cutting of stone in architecture . . . that of sundials, . . . that of perspective. . . .[78]

He emerged as a publishing theorist in 1636, with an essay on the reading and writing of music which he contributed to Mersenne's *Harmonie universelle*, and with his own *Exemple de l'une des manières universelles . . . touchant la pratique de la perspective . . .* (*Example of One of the Manières Universelles of S^r G.D.L. concerning the practice of Perspective without Employing Any Tiers Point, of Distance or of Any Other Kind which Falls Outside the Area of the Work*).[79] In the twelve-page pamphlet with its one compound illustration (pl. 230), he aimed to provide a technique which would subsume all previous methods and provide a completely self-sufficient procedure embracing all possible cases encountered by the practitioner. To accomplish this he devised a double construction within the field of the picture using precise scales and projective geometry to achieve a more detailed degree of spatial calculation than was possible using the standard checker-board floor. A detailed outline of his procedure is provided in the caption to the plate.

The basis of his construction is the creation of two geometric scales. The 'scale of measures' uses orthogonal lines drawn from G to a series of scaled divisions at the base of the picture plane to provide the measures for horizontal dimensions into the depth of the ground plane in a more-or-less standard manner. The 'scale of distances' uses a separate scale of *petits pieds* corresponding to the viewing distance and is produced along the base of the picture from A to C. The intersections of the diagonals FC and AG mark a point 24 units or *pieds* into the space. If further diagonals are drawn from F to divisions on the scale AC, they intersect the diagonal AG at points which give the locations of corresponding depths in the space. Thus the line from F to point '17' marks a position 17 units from the front plane and therefore provides the horizontal coordinate for the near corner of the structure he is projecting. The vertical location of this corner on the horizontal is achieved by transferring the measurement of 1½ units (rm on the plan) from the 'scale of measures' on the right of the construction to give the scaled distance of M from R. The whole technique is neatly ingenious, but the use of two scales along the base of the picture plane and the way in which the viewing distance is manipulated without moving point F would have proved rather disconcerting for painters familiar with the uniformly-scaled method.

Desargues's next significant publication was his *Brouillon project . . .* (*Rough Draft of an Attempt to Deal with the Outcome of a Meeting of a Cone with a Plane*), fifty copies of which were issued in 1639.[80] Besides dealing with such technical questions as points in involution (an example of which we will encounter below) and the perspectival properties of quadrangles inscribed in conic sections, this treatise also contains fundamental statements of a new kind of geometry which had been independently set in motion by Kepler.[81] According to the new principles, straight lines are to be considered as equivalent to curves of infinite radius meeting at infinity. The technical and conceptual innovations which crystallised during his studies of conics seem to have refracted back into his studies of linear perspective and led to the formulation of one of the theorems which bears his name. This states that: if two triangles are produced such that lines connecting pairs of corresponding vertices meet in a point, then the points of intersections of pairs of corresponding sides lie on a straight line; and conversely (pl. 231).

He has brought together a number of concepts in classical geometry—Euclid's Porism and theorems by Pappus and Menelaus—in a new synthesis to provide a theorem of such a fundamental kind in the field of projective geometry that it has on occasion been granted axiomatic status.[82] Its basic proof is normally achieved in three dimensions, and if we envisage it in



230. Metrical perspective projection of a building on a square plan, from Girard Desargues's *Example de l'une des maniéres universelles . . . touchant la pratique de la perspective*, Paris 1636.

Inset drawing upper right: scale plan of object, picture plane, and viewpoint.

Main drawing: (1) Base line AB is divided into 12 feet corresponding to ab in inset drawing upper right. (2) FE = horizon, on which G marks the axis of sight. (3) Diagonals AG and FC give horizontal HD. Inset drawing upper left: (4) Draw ft, giving horizontal qn where ft intersects ag. (5) Draw fo, giving horizontal us, and so on . . . Main drawing: (6) AC is divided into 24 feet corresponding to tc (viewing distance) in inset drawing upper right. (7) HD (see 3 above) is 24 feet behind picture plane. (8) QN is 48 feet behind picture plane, and so on . . . (9) BG and orthogonals to right of GC are drawn. (10) Each intersection of orthogonals on HD, QN, etc. = scale of 1 foot. Thus HD contains 24 scale feet, QN 36 scale feet, etc. To find the position of m. (11) A distance equivalent to ra (upper right inset) is measured on the scale AC, i.e. at point 17. (12) Point 17 is joined to E, and the point at which it intersects AG provides the horizontal R on which M is to be located. (13) A distance equivalent to rm (upper right inset) is measured on the horizontal R using the scale of orthogonals to right of GC. (14) The scaled distance is measured from the intersection of AG and R to give the location of M. (15) All other points on the plan can be produced by procedures equivalent to 11–14 above.

The verticals, V, Z, W, R^1, represent the height of standing figures. The height of the verticals of the house are calculated according to the corresponding horizontal scale.

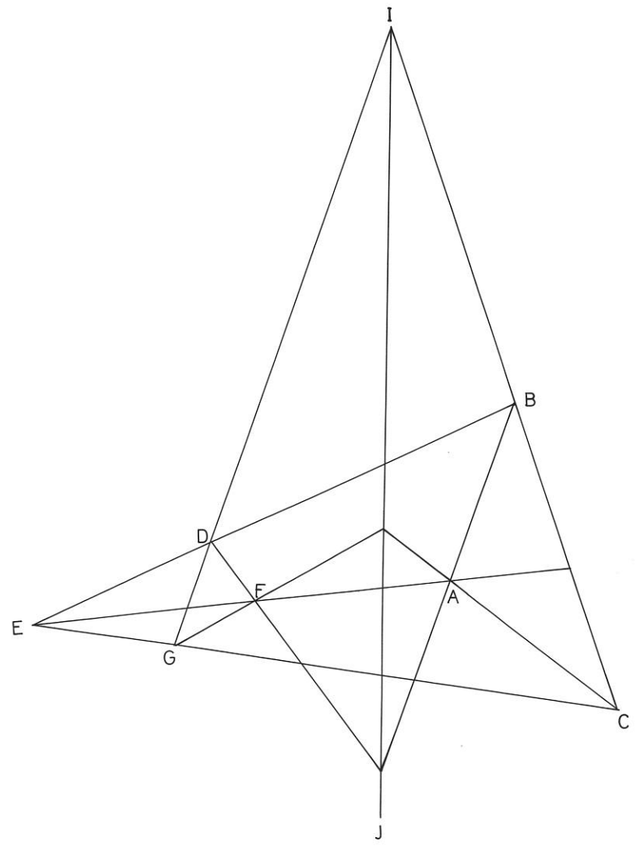
the familiar guise of a picture plane onto which a triangle is projected (pl. 232) we will be more readily able to grasp its essential features in terms of the perspectival techniques which had culminated in Guidobaldo's book. The theorem may have been published in the supplementary *Livret de perspective* which he issued in 1643, and it certainly appeared in Bosse's exposition of Desargues's *Manière universelle* in 1648.[83]

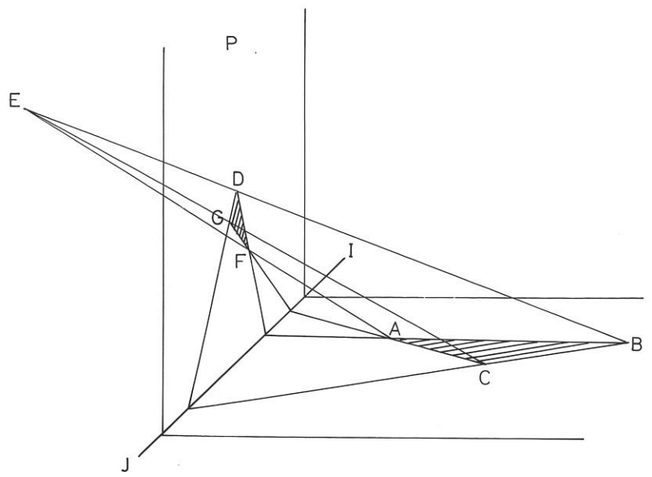
The rich implications of his theorem have been explored by geometers in the nineteenth and twentieth centuries. From our present standpoint it might be interesting to examine two of its relationships with the 'workshop' procedures we have seen so many artists operating. If we take three or more lines (a 'flat pencil' in geometrical terms) diverging from a single point and cutting two non-parallel lines and we draw diagonals between opposite points, the crossings of the diagonals will lie on a straight line. The points are described as in 'involution': i.e. the ratios between them (and other properties of their relative positions) remain constant in projection.[84] The corresponding

231. Desargues's theorem

ABC and DFG—triangles

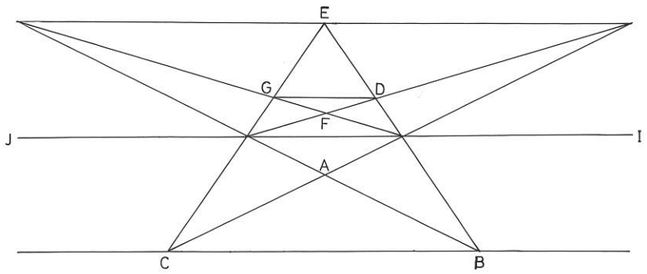
When lines joining the vertices B and D, A and F, C and G converge to a single point, E, the extensions of the opposite sides of the triangles meet on a common line, IJ, and vice versa.





232. Desargues's theorem as a three-dimensional diagram.

E—eye IJ—base of picture plane (P)
ABC is seen as DEF

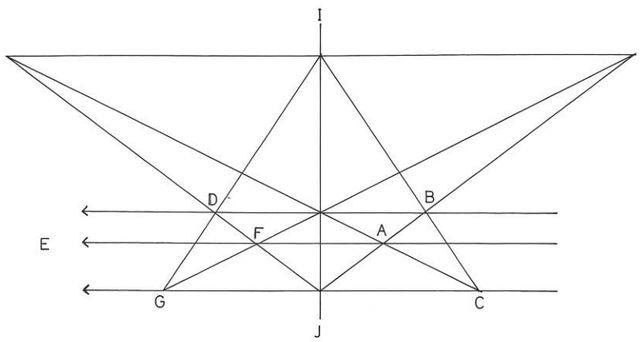


233. Desargues's theorem when two of opposite sides of the triangles are parallel (i.e. meeting at infinity).

ABC and DFG—triangles CB is parallel to GD
(labelled to correspond to pls. 231 and 232)

234. Desargues's theorem when the lines through the vertices are parallel (i.e. meeting at infinity).

ABC and FG—triangles
DB is parallel to FA and GC, meeting at point E at infinity (labelled to correspond to pls. 231 and 232)

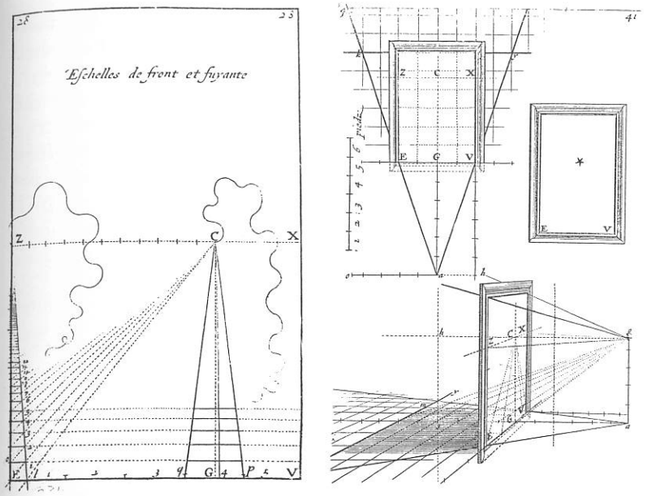


pairs of triangular figures made by the diagonals and the two non-parallel lines will obey Desargues's theorem. Let us now consider two particular cases of this construction: one in which a pair of corresponding sides of two triangles are parallel, i.e. meeting at infinity (pl. 233); and one in which the lines through the vertices are parallel (pl. 234). The identity of both these with elements in our familiar distance-point or *tiers points* construction will be readily apparent. The generality of Desargues's theorem is thus expressed in the particular cases of the triangular sections of our standard tiles in their regular foreshortening.

Within the world of mathematics, Desargues's innovations were largely smothered by the very different techniques of algebraic analysis introduced by Descartes, which rapidly proved their power both in their own field and with respect to the new techniques of calculus.[85] Although Desargues's techniques survived more actively than the standard histories suggest—not only in the work of an immediate disciple, Blaise Pascal, and a later follower, Philippe de la Hire, but also in the literature on stereotomy and perspective—it is true to say that the mathematical implications of his projective techniques were not to be properly realised until their 'rediscovery' by Poncelet and Chasles in the nineteenth century.[86] His perspectival techniques could well have suffered a similar fate in the world of art. Most painters would have been little concerned with his general theorem, and his *Manière universelle* might seem to represent little more than an eccentric byway from the main path of the artists' perspective. However, the actual story is very different. Through his own efforts as a polemicist and with the conspicuous assistance of Abraham Bosse in the Academy, his *Manière* became the centre of a noisily prominent controversy.

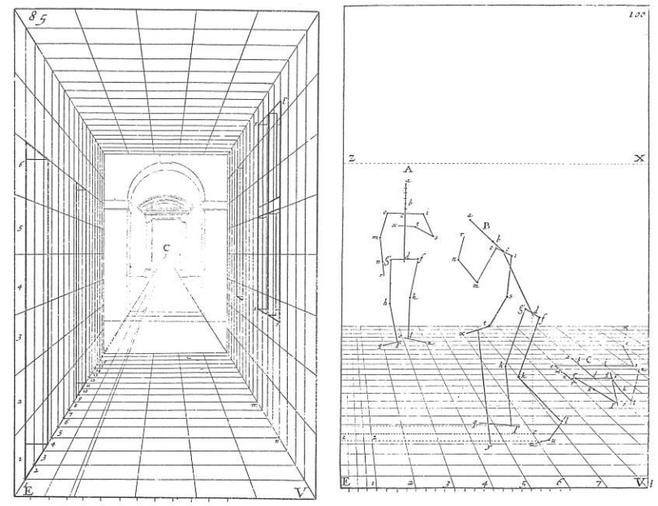
Desargues's work on conics had been the subject of a limited polemic in 1640.[87] Two years later the perspective wars began in earnest on a larger scale. The immediate cause was the publication of *Perspective practique* . . . by a 'Jesuit of Paris' (actually Jean Dubreuil).[88] This was a substantial, effective and not overly technical introduction for artists, which imprudently contained a bowdlerised version of Desargues's *Manière*. The mathematician's response was immediate. He issued two posters (or hand bills) accusing the anonymous author of 'incredible error' and 'enormous mistakes and falsehoods'.[89] Dubreul's answer. in a pamphlet entitled '*Diverses méthodes universelles* . . . , was to accuse Desargues of having plagiarised the ideas of Vaulezard and Aleaume (which does not seem to have been the case).[90] The Jesuit's publishers also issued a collected edition of anti-Desargues pamphlets under the ironic title, *Avis charitables sur les diverses oeuvres et feuilles volantes du Sieur Girard Desargues* (*Charitable Opinions of the Various Works and Leaflets of Sieur Girard Desargues of Lyons*).[91] Desargues replied with pamphlets devoted to *Six Errors on Pages 87, 118, 124, 128, 132 and 134 in the Book Entitled the 'Perspective Practique'* . . . and a *Response to the Sources and Means of Opposition*. . . .[92] Such terms as 'imbecility' and 'mediocrity' were used with undisguised venom by both parties.

In the next year, 1643, Bosse brought out the first of the publications in which he expounded Desargues's views. These



235. Perspective scales from Abraham Bosse's *Manière universelle de M. Desargues pour pratiquer la perspective*, Paris, 1648.

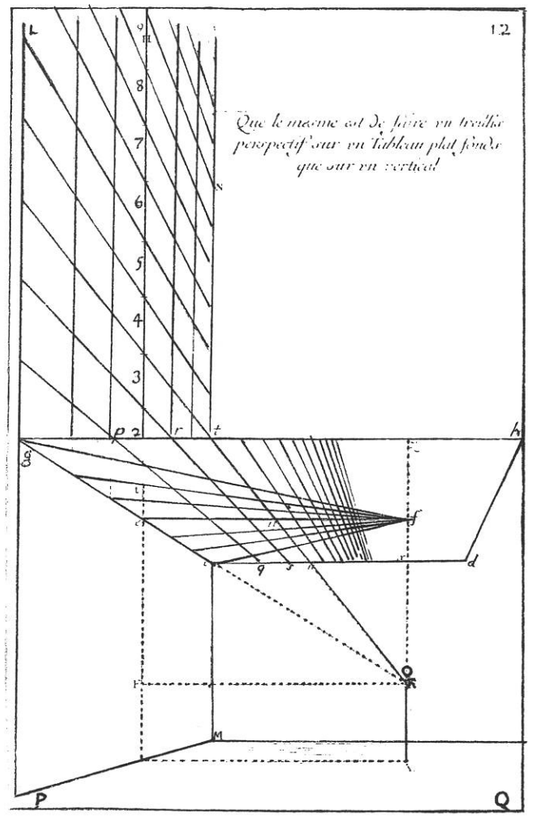
236. Demonstration of the picture plane as a window from Bosse's *Manière universelle*.



237. Scaled box of interior space from Bosse's *Manière universelle*.

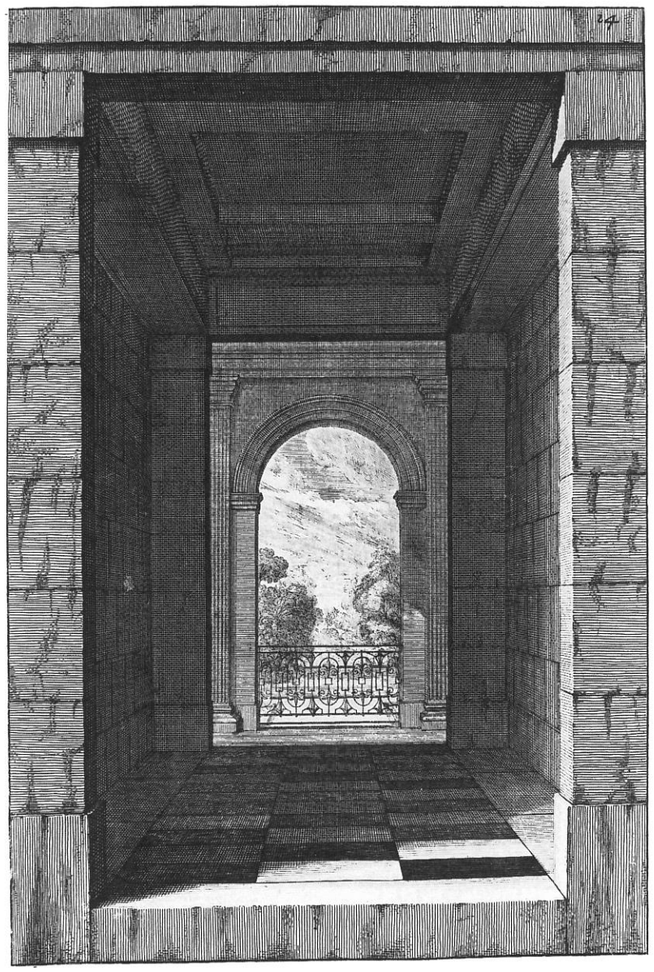
238. Scaled modules for human figures, from Bosse's *Manière universelle*.

239. Perspective projection of a grid design on to a flat ceiling, from Bosse's *Moyen universelle de pratiquer la perspective sur les tableaux ou surfaces irrégulières*.



consisted of treatises devoted to *manières universelles* for the cutting of stones in architecture according to the principles of projective geometry and the making of sundials, etc.[93] These attracted new assaults, this time from an expert in stonecutting, Curabelle, who devoted three pamphlets to the criticism of Desargues's works and of the 'pitiable feebleness' with which the mathematician had reacted.[94] At this distance in time it is perhaps difficult to understand the vehemence, but we should remember that these disagreements were not simply keen disputes over geometrical solutions or theoretical issues; they related directly to the cherished practices of professional groups who were as protective then as such bodies are today.

Initial victory, somewhat surprisingly, seems to have lain with Desargues and Bosse, the 'new' men. This success is perhaps explained by the desire of the founders of the *Acadèmie Royale* to establish their intellectual independence from the older professional bodies such as the guilds.[95] In 1648, shortly after the Academy's foundation, Bosse was invited to provide instruction in perspective. As an engraver by profession he was not eligible for formal election to the Academy, but he was made an Honorary Member in 1651 in recognition of his contribution as a teacher.[96] The publications issued by Bosse during and after his years at the Academy give a clear idea of his courses.[97] He provided direct instruction in Desargues's *Manière*, which was extended to embrace different ways of creating the two scales (pl. 235), the means of relating the underlying geometry to the notion of a picture plane as a 'window' (pl. 236), demonstrations of how a complete box of space can be created (pl. 237), and the scaling of human figures in the space (pl. 238). His expanded publication of the *Manière* in 1648 was followed in 1653 by his *Moyen universelle*, which



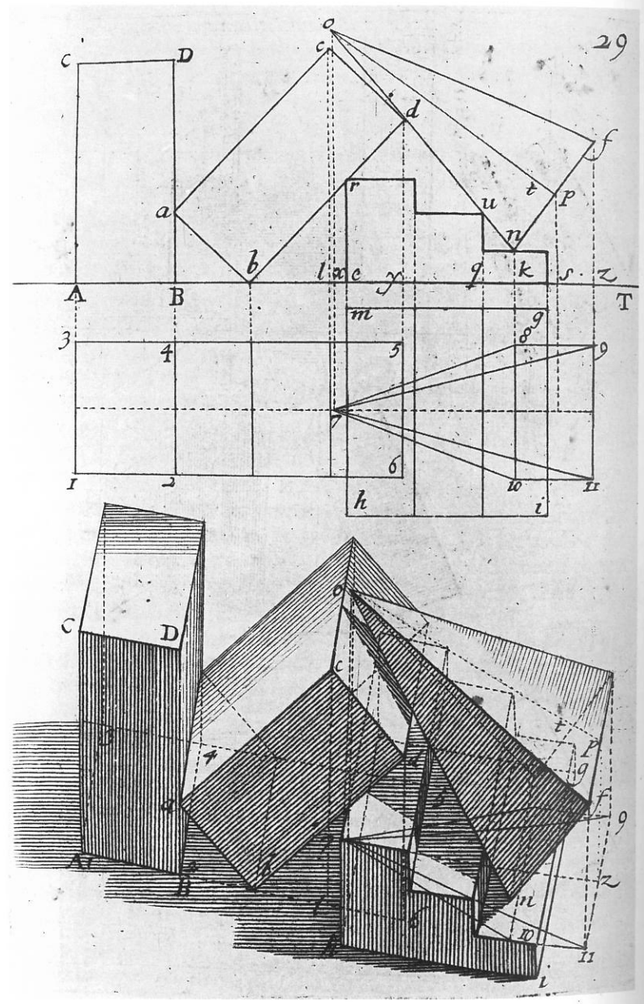
240. Abraham Bosse, Study of architectural perspective with light and shade, from *Traité des manières de dessiner les ordres de l'architecture*, Paris, 1664.

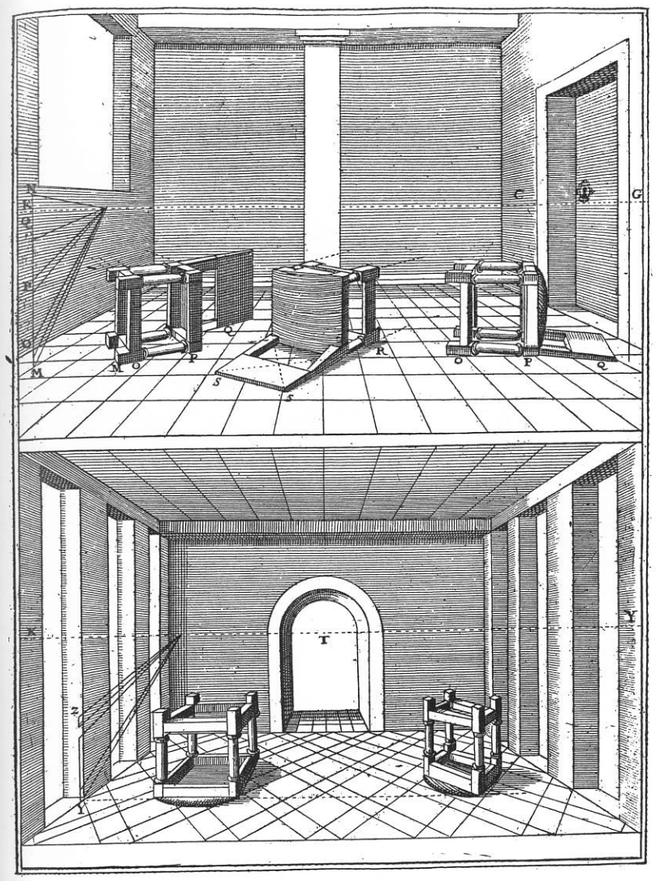
paid particular attention to the illusionistic projection of perspective onto ceilings and vaults of various configurations (pl. 239).[98] Bosse's own engravings, executed with a scrupulous graphic technique characteristic of his whole approach, generally set genre subjects of a moralising or anecdotal kind in meticulous boxes of space.[99] On occasion he found scope for particular tours-de-force of perspectival recession in his subject engravings and book illustrations (pl. 240).

Signs of opposition from within the Academy, above all from Charles Le Brun, began to appear as early as 1651 but were at first containable. Bosse was able to rely upon substantial support, not least from Laurent de la Hire, whose son Philippe has already been mentioned as one of Desargues's few successors in the seventeenth century. By 1657, however, serious trouble was brewing. Le Brun had begun to insinuate

his own man, Jacques Le Bicheur, into the Academy as an authority on perspective, and to use Leonardo's newly published *Treatise on Painting* to undermine Bosse's doctrinaire insistence on geometrical devices. It was helpful in this respect that the particular selection of Leonardo's writings in the manuscript compilations of the *Trattato* which were used for the 1651 edition included little in the way of detailed instructions for perspectival construction.[100] Matters came to a head in 1660 when Le Bicheur published his *Traitè de perspective*, prominently dedicated to Le Brun.[101] Bosse issued a pamphlet of vigorous criticism against the 'derivations, disfigurements and falsifications' in the new treatise and petitioned for its examination by the Academy.[102] By this time, the Le Brun faction was

241. Perspective study of geometrical bodies with shadows from Bosse's *Traité des pratiques géométrales et perspectives*, Paris, 1665.





242. Demonstration of foreshortened objects in a perspectival interior, from Jean Dubreuil's *Perspective practique*. . . , Paris, 1642.

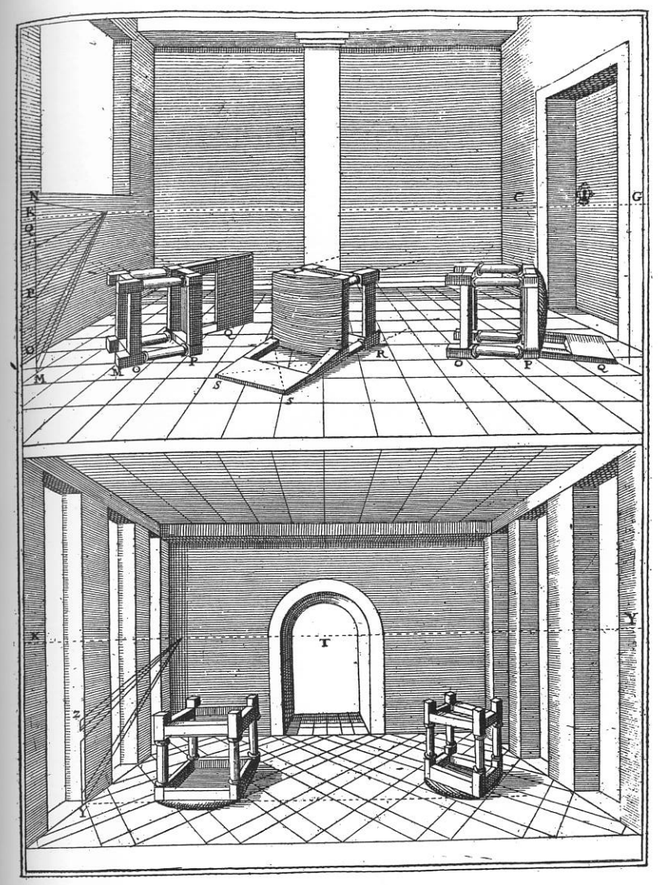
ready to exercise its increasing muscle, and matters went badly for Bosse. . . 'One member of the Academy questioned the credentials of the said M. Bosse. The latter became highly agitated and withdrew, whereupon the assembly postponed its deliberations until another day.'[103] The unhappy result was the expulsion of Bosse in 1661, 'removing all rights and privileges accorded to him, forbidding him further entrance to the Academy, refusing to accept or read any more of his leaflets'.[104] The following year an order was obtained 'on pain of prison' to stop Bosse from spreading his 'libels' about the Academy.[105]

A less resolute character might have been tempted to give up in disgust, but Bosse continued publishing. His *Traité des practiques géométrales et perspectives*. . . (*Treatise of Practical Geometry and Perspective as Taught at the Royal Academy of Painting and Sculpture*), issued in 1665, is a succinct and uncompromising synthesis of his teachings.[106] The first part concentrates on the geometry of the 'sphere, circle, cone and cylinder', while the second provides systematic instruction in the rendering of objects in space (pl. 241). Towards the end he specifically addresses the activities of 'the new Reformer' (Le Bicheur or Le Brun?) who is leading the youth of the Academy astray by pretending that they can dispense with Bosse's precise techniques in favour of judgement by eye.[107]

These disputes were not just concerned with which techniques were to be preferred. They more profoundly involved the relationships between theoretical prescription, visual judgement, practical procedures, and artistic ends. Dubreuil would have agreed with Bosse that failure to master the rules was not to be commended: 'however excellent a painter may be, he must follow all these rules or end up appealing only to the ignorant'.[108] But Dubreuil's rules are only to be pursued as far as is useful to the practising artist (pl. 242), and he accordingly accommodates himself 'to the capacity of Learners; not perplexing them with many Demonstrations'.[109] In a later publication, this practical attitude has been softened even further: 'neither I nor my like have enough patience to bind ourselves to these rules' in every respect when wishing to achieve the desired effects.[110]

The challenge mounted by Le Bicheur, and in a more substantial way by Grégoire Huret in 1670, was potentially more corrosive than Dubreuil's pragmatism and loss of patience.[111] Huret's *Optique de portraicture et peinture* is an uneven work, exhibiting demonstrations of some geometrical ingenuity alongside passages which unsettle the reader's faith in his capacities. The latter part of his treatise is devoted to an anti-Bosse polemic in the intemperate tone which characterised earlier contributions to the debate. Although he goes to some length to illustrate the geometrical procedures, he clearly regards them as serving the end of pedagogical completeness rather than providing techniques which would be of universal application in the making of a picture which recreates natural effects. In practice, the formulae of geometrical perspective hold sway only in a limited sphere of operation, namely when the artist wishes to create an illusion of space by portraying architectural forms disposed in a regular manner. For irregular bodies and for those disposed irregularly it is necessary 'to multiply the visual angles, and. . . distribute various points of convergence along the horizon line of the picture' as if the visual axis is rotating—a view which recalls Viator's account from over a century-and-a-half earlier.[112] In portraying the bodies of man and animals Huret grants 'the liberty to the painter to draw them without any perspectival distortion on the picture plane, just as the eyes see them in life'.[113] This is a plea for a flexible response to 'natural vision' and 'judgement by eye' in portraying complex forms and scenes, and represents a probably unwitting articulation of the standpoint we have previously inferred in the cases of Rubens and Velázquez. Not surprisingly he criticized Cousin, Barbaro, Marolois and Desargues for taking mathematical perspective beyond its visual limits.[114]

The pragmatism of Dubreuil and the more overt challenge of Huret bring us face to face with the central issue for painters, namely what all this theorising has to do with the practice of art. It would be easy to dismiss the perspectivists' polemics as storms in a theoretical teacup, but we should remember that



242. Demonstration of foreshortened objects in a perspectival interior, from Jean Dubreuil's *Perspective practique*. . . , Paris, 1642.

ready to exercise its increasing muscle, and matters went badly for Bosse. . . 'One member of the Academy questioned the credentials of the said M. Bosse. The latter became highly agitated and withdrew, whereupon the assembly postponed its deliberations until another day.'[103] The unhappy result was the expulsion of Bosse in 1661, 'removing all rights and privileges accorded to him, forbidding him further entrance to the Academy, refusing to accept or read any more of his leaflets'.[104] The following year an order was obtained 'on pain of prison' to stop Bosse from spreading his 'libels' about the Academy.[105]

A less resolute character might have been tempted to give up in disgust, but Bosse continued publishing. His *Traité des practiques géométrales et perspectives*. . . (*Treatise of Practical Geometry and Perspective as Taught at the Royal Academy of Painting and Sculpture*), issued in 1665, is a succinct and uncompromising synthesis of his teachings.[106] The first part concentrates on the geometry of the 'sphere, circle, cone and cylinder', while the second provides systematic instruction in the rendering of objects in space (pl. 241). Towards the end he specifically addresses the activities of 'the new Reformer' (Le Bicheur or Le Brun?) who is leading the youth of the Academy astray by pretending that they can dispense with Bosse's precise techniques in favour of judgement by eye.[107]

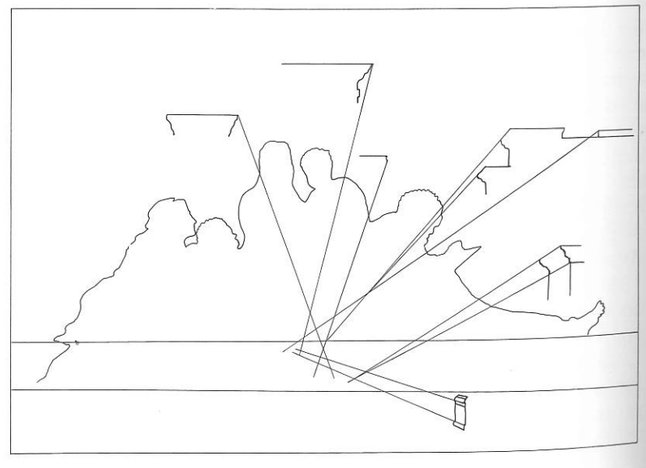
These disputes were not just concerned with which techniques were to be preferred. They more profoundly involved the relationships between theoretical prescription, visual judgement, practical procedures, and artistic ends. Dubreuil would have agreed with Bosse that failure to master the rules was not to be commended: 'however excellent a painter may be, he must follow all these rules or end up appealing only to the ignorant'.[108] But Dubreuil's rules are only to be pursued as far as is useful to the practising artist (pl. 242), and he accordingly accommodates himself 'to the capacity of Learners; not perplexing them with many Demonstrations'.[109] In a later publication, this practical attitude has been softened even further: 'neither I nor my like have enough patience to bind ourselves to these rules' in every respect when wishing to achieve the desired effects.[110]

The challenge mounted by Le Bicheur, and in a more substantial way by Grégoire Huret in 1670, was potentially more corrosive than Dubreuil's pragmatism and loss of patience.[111] Huret's *Optique de portraicture et peinture* is an uneven work, exhibiting demonstrations of some geometrical ingenuity alongside passages which unsettle the reader's faith in his capacities. The latter part of his treatise is devoted to an anti-Bosse polemic in the intemperate tone which characterised earlier contributions to the debate. Although he goes to some length to illustrate the geometrical procedures, he clearly regards them as serving the end of pedagogical completeness rather than providing techniques which would be of universal application in the making of a picture which recreates natural effects. In practice, the formulae of geometrical perspective hold sway only in a limited sphere of operation, namely when the artist wishes to create an illusion of space by portraying architectural forms disposed in a regular manner. For irregular bodies and for those disposed irregularly it is necessary 'to multiply the visual angles, and. . . distribute various points of convergence along the horizon line of the picture' as if the visual axis is rotating—a view which recalls Viator's account from over a century-and-a-half earlier.[112] In portraying the bodies of man and animals Huret grants 'the liberty to the painter to draw them without any perspectival distortion on the picture plane, just as the eyes see them in life'.[113] This is a plea for a flexible response to 'natural vision' and 'judgement by eye' in portraying complex forms and scenes, and represents a probably unwitting articulation of the standpoint we have previously inferred in the cases of Rubens and Velázquez. Not surprisingly he criticized Cousin, Barbaro, Marolois and Desargues for taking mathematical perspective beyond its visual limits.[114]

The pragmatism of Dubreuil and the more overt challenge of Huret bring us face to face with the central issue for painters, namely what all this theorising has to do with the practice of art. It would be easy to dismiss the perspectivists' polemics as storms in a theoretical teacup, but we should remember that

243. Nicolas Poussin, *Holy Family on the Steps*, *c.*1646, National Gallery, Washington.

244. Analysis of the perspective in Poussin's *Holy Family on the Steps*.



practising artists—amongst whom we must of course number Bosse himself—played active roles both as theorists and as members of the newly-founded Academy, which took upon itself direct responsibility for the intellectual well-being of the profession. The greatest French painter of the era, Nicolas Poussin, certainly did not participate in any direct sense, not least because his career was largely based in Rome. However, his art had established itself as the supreme exemplar for his French contemporaries, and we will not be surprised to find that participants in the debates were keen to adduce him in their support. Le Brun saw himself as the guardian of Poussiniste standards, and must have been rather disconcerted to find the great master being quoted back at him by Bosse. Since Le Brun was using the newly-available *Trattato* of Leonardo as a stick with which to beat the engraver, it was in Bosse's interests to diminish the worth and even to question the authen-

Steps.

ticity of the published compilation. His most potent weapon in this respect was a letter from Poussin, whose services had earlier been enlisted to provide illustrations for the *Trattato*. Bosse quoted Poussin to the effect that anything of value in the Leonardo treatise could be written on a single side of paper in large letters.[115] Although Bosse's own testimony is the only evidence we have for this opinion, he did publish it during Poussin's lifetime and it is unlikely to have been entirely fabricated.

Poussin's surviving statements about his own principles are themselves compressed to the point of terseness, when compared to the rhetorical inflation which seemed the norm in much art theory. As they stand they do much to encourage the absolutist stance of Bosse on questions of visual truth. 'Good judgement', Poussin informed his patron Paul Fréart de Chantelou, 'is very difficult unless one knows that theory and practice are united together in great art. We must not judge by our sense alone but by reason.'[116] Bellori records Poussin as saying that 'painting is nothing but an idea of incorporeal things, even if it is displayed in bodies, and represents only the order and the mode and the species of things'—which paraphrases the Neoplatonic philosopher Marsilio Ficino, who had been similarly quoted by Dürer and Lomazzo.[117] Even more overtly geometrical is a letter of 1641–2 in which he states that there are two procedures for viewing objects:

> one is by simple seeing, and the other ponders them attentively. Simple seeing is nothing other than the natural reception in the eye of the form and resemblance of the seen object. But to see an object with deliberation . . . we search with a particular procedure for a way to understand that same object properly. Therefore we may say that simple 'aspect' is a natural operation, while that which I call 'prospect' is a function of reason and depends on three things—knowledge of the eye, of the visual ray and of the distance from the eye to the object.[118]

This formulation has been shown to be drawn directly from the introductory section of Daniele Barbaro's *La Pratica della perspettiva*, with the Italian's *perspettiva* translated as 'prospect'.[119]

The Italian flavour of these ideas is not surprising given Poussin's declared allegiance to the great Renaissance masters. The strength of his contacts with the Leonardo tradition—notwithstanding his later reservations about the *Trattato*—have recently become clearer with the rediscovery of four manuscripts by Matteo Zaccolini, at least one of which was specifically copied for Poussin by his brother-in-law, Jean Dughet.[120] Zaccolini was a minor painter and architectural designer with a line in illusionism, whose writings as a theorist exhibit a lively understanding of the visual science of art in the Leonardo succession, as we will see in the next section and in Chapter VI. The manuscript on light and shade copied for Poussin exercised a direct impact on his treatment of shadows cast by multiple light sources, above all in the *Eucharist* from the series of 'Sacraments' commissioned by Cassiano del Pozzo, who was librarian to the Barberini and played a major role in the preservation and transmission of the Zaccolini manuscripts.[121] When we also find Poussin summarising the Alhazen-Witelo views on the conditions necessary for sight, we have further evidence of the essential compatibility of his attitudes with Renaissance predecessors such as Ghiberti, Piero and Leonardo: 'nothing is visible without light; nothing is visible without a transparent medium; nothing is visible without colour; nothing is visible without distance; nothing is visible without a mechanism'.[122]

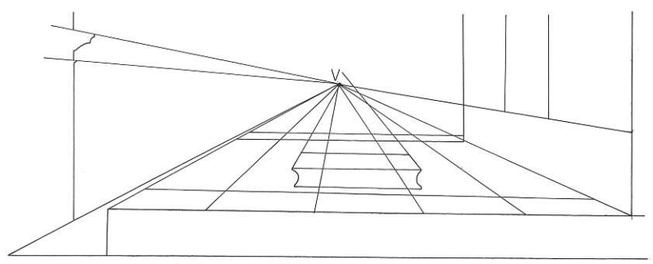
When we look to his actual paintings, the impression that we may be dealing with a 'Baroque Piero della Francesca' appears at first sight to be amply reinforced. The *Holy Family on the Steps* (pl. 243) has recently been assessed in just these terms:

> the picture is as perfect and as cool as a proposition from Euclid. Our eyes perceive the perspective and other geometrical relationships in the constructed space. . . . Still, he seems to have purposely telescoped recessional features such as the steps, in order to accentuate the foreground composition and keep our awareness of the picture plane. . . . The result is a densely rich interplay between the surface of the painted canvas and the fictive space.[123]

This could have been written about Domenico Veneziano or Piero—and how it would have pleased Bosse! But if we subject Poussin's picture to the kind of analysis the Renaissance paintings sustained, we will find that the perspective has been constructed with decidedly non-Euclidean approximations (pl. 244). The whole 'air' of solid geometry, which is as apparent in the preparatory drawings as in the painting, is based upon visual effect rather than precisely mathematical calculation. He has, to adopt his own terminology, used his mastery of 'aspect' to convey the impression of 'prospect'.

There were other occasions on which he certainly went to greater lengths to obey the basic rules. The lower section of the *Ecstasy of St. Paul* (colour plate V), which we will be studying in connection with Poussin's use of colour in Chapter V, exhibits a fair measure of constructive rationale (pl. 245). The motif of the sword, book and niche is conceived with a care for light, shade, volume and space which is entirely in keeping with the teachings of Zaccolini (pl. 257 below). A nicely characteristic touch is the slight but perceptible curve of the sword blade under its own weight. Other of his later paintings, most notably the *Death of Sapphira* (pl. 246), place narrative subjects

245. Analysis of the perspective in Poussin's *Ecstasy of St. Paul*.



246. Nicolas Poussin, *Death of Sapphira*, Paris, *c.*1654, Louvre.

in spatial settings which are as deep and elaborate as anything we have seen since Piero's *Flagellation*.[124] The major lines of the construction appear to have been carefully laid in, and the lighting of the distant buildings enhances their 'Euclidian air'. Even here, however, we are not dealing with an absolute system. The disposition of the pavement pattern and steps appears to be contrived more for visual effect than to underline the logic of the construction, and many of the apparently perspectival details of the buildings, such as rows of capitals and window pediments, have been added freehand.

As a witness in our debate, therefore, Poussin provides ambiguous testimony. If, as Bosse and Roland Fréart de Chambray wished to believe, Poussin supported the absolutist line, the master's statements and the 'look' of his paintings did much to encourage them. Chambray, the brother of Poussin's most faithful French patron, Paul Fréart, was the French translator of Euclid's *Optics*, and author of the *Idée de la perfection de la peinture*, in which he propounded the basic features of perspective as a series of axioms.[125] This approach reflected his conviction that art relied on 'the perfect intelligence of the Principles, primarily Perspective and Geometry, without which painting cannot subsist'.[126] Poussin reacted with what we may sense to be guarded warmth in 1665 when he acknowledged the treatise which Chambray had sent for his approbation.[127] On the other hand, if Le Brun, Le Bicheur and Huret wished to claim Poussin as a supporter of their less dogmatically scientific orientations, the actual practice of perspective in the master's art would do much to sustain their criticisms of Bosse's unwavering adherence to geometrical rule. Perhaps Félibien, Poussin's perceptive biographer, strikes the right balance in his undogmatic assessment of the interaction of theory and practice in the master's work.[128]

We do know that Desargues and Bosse received support from a number of painters at the Academy. One account indicates that Philippe de Champaigne had availed himself of Desargues's advice as early as 1628, when he was painting a vault in L'Eglise de Carmel, but since the painting is lost we cannot tell how far he went in adopting the mathematician's techniques.[129] His other paintings exhibit a good level of perspectival competence, but hardly show him as a Desarguian. Laurent de la Hire may be firmly associated with the Bosse camp. He was one of those who supported Bosse at the Academy, and his own works, particularly his drawings, exhibit a studied care for spatial structure whenever architectural or other regular features were to be parts of a composition. His *Allegory of Geometry* (pl. 247), painted in 1649 as part of a set which includes the beautiful *Music* in the Metropolitan Museum, stands as an appropriate monument to the timeless principles of geometrical clarity.[130] A fusillade of paint brushes beside the globe stresses that painting properly belongs in this intellectual realm. Laurent's son, Philippe, whom we have already characterised as one of Desargues's few immediate successors as a geometrician, was responsible for the only surviving transcription of Desargues's work on conics. As a professor at the French Royal Academy of Architecture from 1687, Philippe actively sustained the Desarguian tradition in at least one field of artistic endeavour.[131]

The painter whose works declare the most direct implementation of the Desargues-Bosse methods is Eustache Le Sueur. The evidence of his drawings shows clearly that he used a form of Bosse's perspective scales. His study for the *Presentation in the Temple* (pl. 248) contains two crossed diagonals, one of which is divided into a 'scale of distances', and a scaled vertical with numbered divisions. The elaborately coordinated space in the drawing is used in an understated manner in the actual painting, but the fact of its underlying presence would have been all-important for a theorist of Bosse's persuasion.[132] When the occasion demanded, Le Sueur transposed his Desarguian geometry more openly into the finished picture. The major project he undertook during his relatively short career was a series of paintings in 1645–8 for the Chartreuse of Paris. In addition to a set of stories of St. Bruno, effectively narrated in succinct spaces, he painted a set

247. Laurent de la Hire, *Allegory of Geometry*, 1649, Ohio, Toledo Museum of Art.

248. Eustache le Sueur, Study for the *Presentation in the Temple*, *c.*1652, Paris, Louvre, Cabinet des Dessins, 9191.

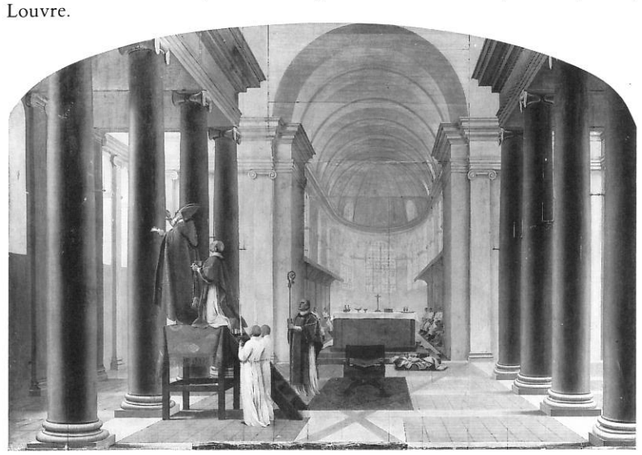
of illusionistic canvases for the corners of a cloister, including the compellingly perspectival *Dedication of a Carthusian Church* (pl. 249).[133] No Dutch artist could have been more meticulous in controlling the spatial effects in a church interior. Le Sueur also had the advantage which few of the Dutch artists possessed, namely that the classical forms of his architecture openly aid and abet the lucid geometry of space. Particularly nice is the asymmetric curve described by the cornice of the apse as seen from the off-centre viewing position.

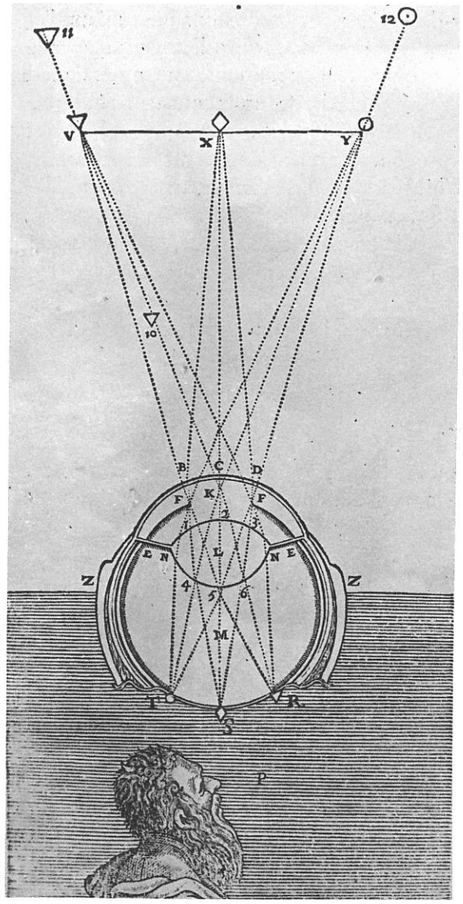
The vigorous theoretical disputes and their fertile engagement with practice occurred at a period in France of great intellectual vigour. Father Marin Mersenne of the Order of Minims was very much at the centre of this activity in Paris, spinning his elaborate web of correspondence across those European centres which were in the forefront of new ideas in science and philosophy.[134] His Academia Parisiensis provided from 1635 a testing-ground for new ideas, including those of Desargues and most especially of René Descartes. Although the greater part of Descartes's working career was spent in the Netherlands, Mersenne helped ensure that he retained a powerful personal presence in French intellectual life. This intellectual context inevitably raises the question of the potential relationship between the artistic battles over spatial representation and the new concepts of space in Cartesian and other modern science.

If we look for direct links between the painters, perspectivists, scientists and philosophers, they are not hard to find. Desargues's involvement with Mersenne is amply documented, as are his friendly contacts with Descartes.[135] Of the professional painters, Poussin's intellectual associations are best documented. During his period in Paris, after 1640, he associated with a group of men sympathetically disposed to the mathematicising of science, most notably Pierre Gassendi, a keen Copernican and supporter of Galileo.[136] Amongst the perspective theorists, Jean-François Niceron, whose theories were first published in 1646, showed the most up-to-date awareness of the ideas of Galileo, Kepler and Descartes, as befitted a fellow member of Mersenne's order.[137] The French version of Niceron's *Thaumaturgus opticus* (*La Perspective curieuse*) was coupled in a 1663 edition with Mersenne's book on optics and catoptrics.[138]

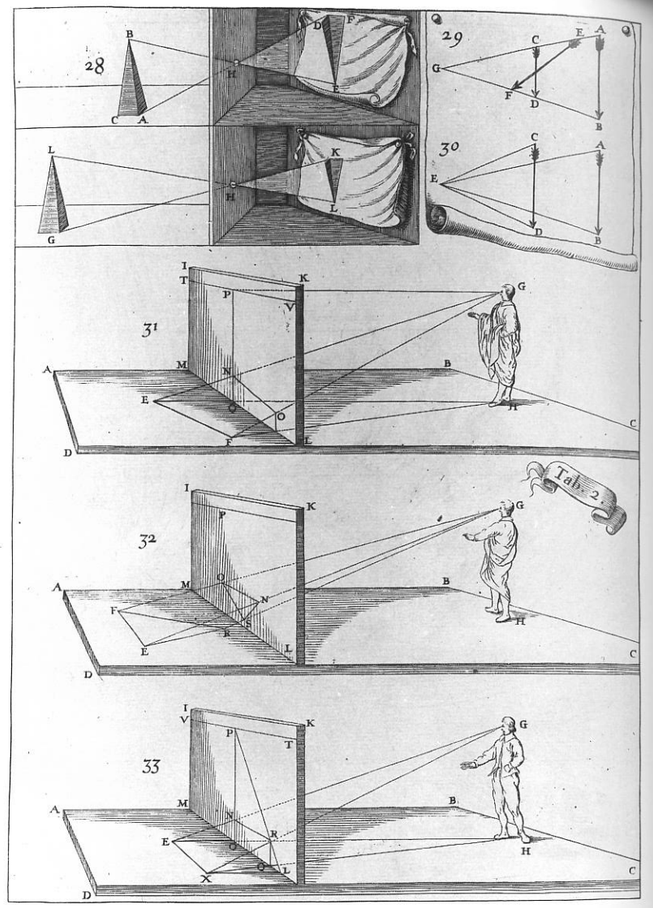
However, we should hesitate before we begin to weld this into a unified and seductive whole, seeing the art of painting as an integral and fully coherent part of a French intellectual movement. The geometrical approaches of Desargues and Descartes—the one projective and the other algebraic—were founded on utterly divergent techniques, as they recognised themselves. Even their views on space were different. Desargues posited the meeting of parallel lines at infinity as a geometrical 'reality', without exploring its philosophical connotations, while Descartes on philosophical grounds would only go as far as to accept the 'indefiniteness of extension'.[139] Gassendi, Poussin's friend, disagreed violently with Descartes on fundamental issues of philosophy. Niceron was associated not with the artists of the Royal Academy, but with Simon Vouet, who was at the centre of the Paris Guild's rival foundation, the Academy of St. Luke.[140] The more we look into the individual cases, the more factional fragmentation becomes apparent on a variety of social, intellectual and artistic grounds.

249. Eustache le Sueur, *Dedication of a Carthusian Church*, 1645–8, Paris, Louvre.





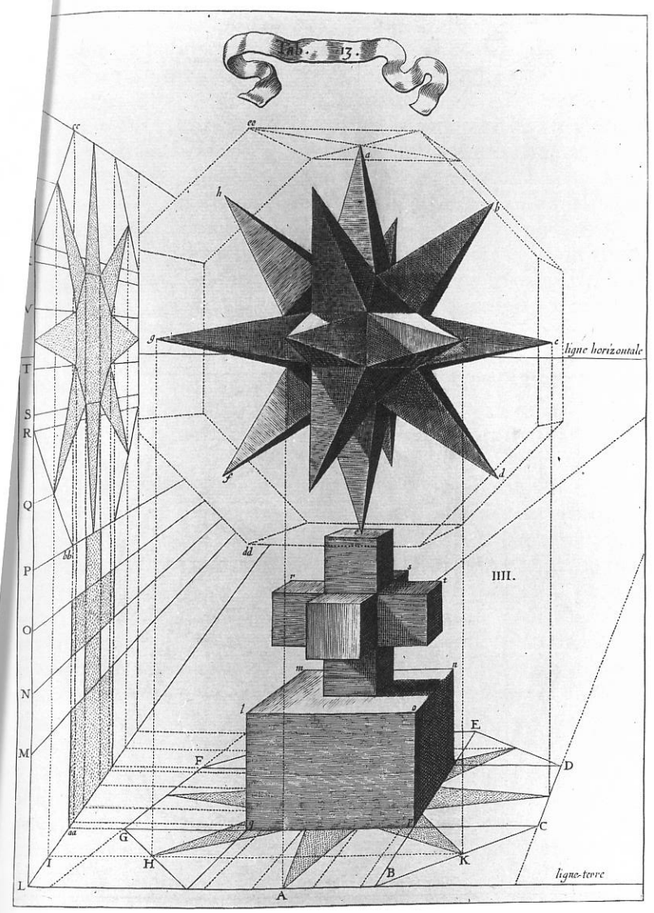
250. The optical system of the eye, from Descartes's *Discours de la méthode plus la dioptrique, les météores et la géométrie'*, Leiden, 1637.



251. The camera obscura as an analogy for the human eye and demonstrations of the picture plane, from Jean François Niceron's *Thaumaturgus opticus*, Paris, 1646.

Historians are by nature synthesisers, looking for patterns, sensing underlying themes, even searching for some kind of unity beneath the apparent chaos of appearance. Uncomfortable as it may be, I think we should say clearly when we fail to find a clear pattern. It would be tempting to weave an attractive tapestry from the artist's perspective, projective geometry, the physical sciences and philosophy, showing the major French protagonists marching heroically along the same strenuous road towards the new visions of space. The historical evidence relating directly to the science of art does not seem to me to support such a vision—at least as far as painting is concerned. This is not to deny that aspects of the new thought did impinge creatively upon art. The annexing by Le Brun of Cartesian ideas on the passions to the portrayal of feeling in history painting is well proven.[141] And the perspective 'tricks' of Niceron, which we will encounter in a later chapter, are open to interpretation in a more-or-less Cartesian framework.[142] But the actual theory of *pictorial* space, as expounded by Desargues no less than other theorists, remained obstinately apart from the new ideas in their most philosophically radical guise.

Poussin will again provide a good touchstone. The writings which provided him with the most directly amenable sources for his ideas were entirely traditional—Daniele Barbaro for perspective, Alhazen and Witelo for optics, Lomazzo, Dürer and Ficino for beauty, and Zarlino (who was by this time a dated musical theorist) for the idea of the 'modes', which we will outline when we later look at Poussin's use of colour.[143] This traditionalism is, I believe, an indication that the artistic debate in seventeenth-century France about the relationships between nature, art, order and mathematics used frames of reference which had been laid down before 1600, particularly



252. Composition of geometrical bodies in perspective with cast shadows, from Niceron's *Thaumaturgus opticus*.

in Italy. Poussin's ideas on the geometrical scrutiny of nature, according to the rules of 'prospect', would in a general sense have been sympathetic to French Cartesians and Galileans—and vice versa—but this affinity does not necessarily bear witness to a great unity of purpose at the heart of a shared revolution at this particular time.

In the world of art theory, Niceron, the most 'scientifically advanced' author after Desargues, will provide a similar picture. He was fully aware of Kepler's and Descartes's new concepts of lens focusing an inverted image of the surface of the retina (pl. 250), and he illustrated a camera obscura to demonstrate the basic mechanism (pl. 251). However, there is no suggestion that Cartesian optics should provide the basis for a new system of pictorial representation, and the revised conception of the eye is simply used to show that the existing formulas for the perspectival ratios of size and distance are valid. Indeed, Descartes's subtle definitions of the relationships between optics, opthalmology and intellectual perception in his *Discours de la méthode* were devoted to the examination of questions essentially different from those of the geometrical or pictorial perspectivist.[144] It was understandably difficult for traditional perspectivists to see any immediate consequences of Descartes's ideas for the techniques with which they were concerned. Descartes's emphases upon the deceptiveness of visual appearance and the relativity of the perception of size and distance were undoubtedly relevant to picture-makers, particularly those concerned with the kind of illusionistic 'devices' we will be studying in Chapter IV. However, as far as the art theorists were concerned, Alhazen and Witelo had already made similar points in an entirely adequate manner.

We will not be surprised, therefore, to find that Niceron's perspectival optics are founded on traditional principles, and that he continued to rely upon constructional techniques similar to those of Marolois and Desargues. These techniques are devoted to such standard problems as the exposition of geometrical bodies in space (pl. 252). The second part of his work, which is primarily devoted to anamorphic images (and will be discussed later) is more novel, but nowhere does he adopt an intellectual stance towards visual geometry which could not be accommodated by Barbaro, Danti or Marolois.

These two case studies do, I think, point to a broader truth—that the most advanced thought of the Scientific Revolution was moving to philosophical and technical positions in the mathematical and physical sciences which took them increasingly beyond the range of ready applicability to the needs of art. Once the raw material, techniques and mechanisms of the new sciences and artists' perspective moved on to different footings, the dialogue between science and art would need to change its premises—if it was to survive at all at a high level of intellectual significance in both fields. This is a topic to which we will necessarily return.

ITALY c.1600–c.1770: TRADITIONALISM AND NEWTONIANISM

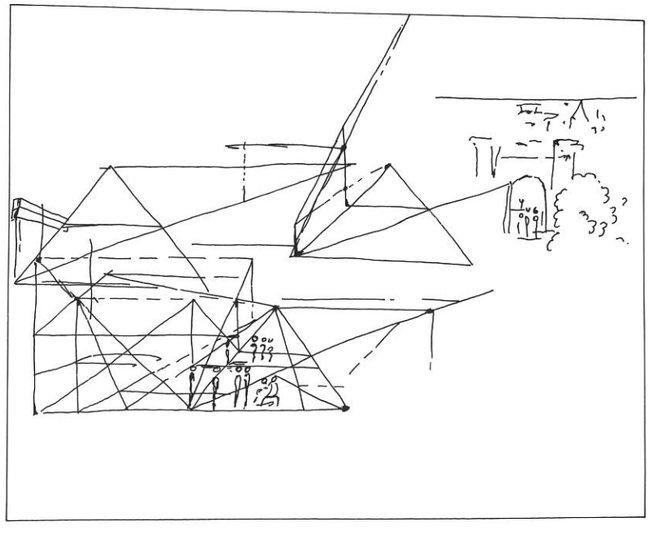
The position of geometrical perspective in Italy after 1600 continued to reflect the long-standing integration of perspective with the rudiments of art. This situation holds good well into the later part of the eighteenth century and is marked by a particularly Italian sense of continuity, which is actively reinforced by regular cycles of revivalism as new generations of artists returned for fresh inspiration to the great High Renaissance masters. This continuity predisposed Italian theorists towards a conservative stance on the necessity for the academic fundamentals such as perspective and anatomy in their standard forms. However, as we shall see, the traditionalist stance did prove surprisingly compatible with ideas from the new sciences in the particular form in which they were absorbed into the mainstream of Italian thought.

Standard histories of Italian painting in the later part of the sixteenth and earlier part of the seventeenth centuries naturally

tend to emphasise the new concepts as they come along—the strictures of the Counter-Reformation, the idealising stance of Zuccaro, the so-called eclecticism of the Carracci, the assertive naturalism of Caravaggio and the new baroque complexities of Pietro da Cortona. But beneath all these eye-catching developments, there was a good deal of traditionalism in the main body of artistic theory and practice, particularly in the academies. In Rome, within Zuccaro's academy, Tommaso Laureti and the Alberti brothers helped to sustain the tradition of perspectival orthodoxy into the seventeenth century. Perspective practice in the Piero della Francesca succession continued to be expressed with impeccable rectitude by Romano Alberti, in the context of his writings about the Roman Academy, and Lorenzo Sirigatti, whose *La Practica di prospettiva* in 1596 provided lucid and attractive demonstrations of the intersection method for geometrical bodies in a way which would not have been out of place in the two preceding centuries.[145]

The Carracci family, who provided the focus for much of the thinking about art in Bologna and Rome in the early seventeenth century, cannot really be claimed as strong partisans of the science of art. However, their successive academies certainly would not have ignored the desirability of perspective studies for the young artist. Ludovico Carracci's *Annunciation*, painted in the mid-1580s, shows that he could turn his hand to an overt demonstration of geometrical space when the subject required the depiction of a regular interior.[146] Against this, it must be admitted that the central work in Annibale's career, the painted ceiling of the Gallery in the Farnese Palace, rejects more of the perspectival-illusionist tradition than it accepts. And this rejection is made all the sharper by the previous engagement of Cherubino and probably also Giovanni Alberti on the project.[147] But Annibale had himself seriously considered 'Bolognese-style' schemes, including one idea for foreshortened Solomonic columns in the familiar fashion.[148] It is also worth noting that a number of his drawings, including a study for the ceiling of the Cerasi Chapel, contain freehand variations on systems of pictorial scaling (pl. 253).[149] There is no reason to think that Annibale was openly hostile to orthodox perspective as such, but he was not prepared to be constricted by its requirements in particular decorative schemes.

253. Transcription of the freehand perspectival study in Annibale Carracci's drawing for *Domine quo vadis*, *c.*1600–1, Vienna, Albertina.

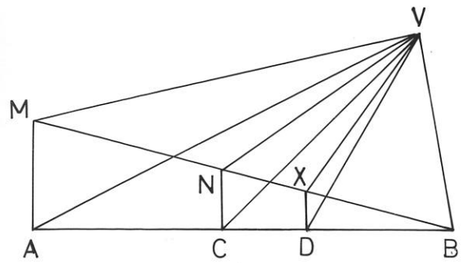


Annibale's major follower, Domenichino, seems to have been more closely concerned with the scientific basis of art, and was instructed in perspective by one of the least known yet most original theorists of his period, Matteo Zaccolini.[150] The setting for Zaccolini's writings, which will be assessed shortly, and Domenichino's practice is what may reasonably be called a Leonardo revival in both Rome and Florence at this time. Manuscript abridgements of Leonardo's 'Treatise on Painting' had continued to circulate in academic circles during the sixteenth century, but it was in the early seventeenth that Leonardo's particularly insistent message of taking Nature as the only 'mistress' began to seem especially relevant.[151] Annibale regretted that he had not read the '*Trattato*' earlier in his career, and in his orbit Guido Reni is known to have possessed a copy. Another version was acquired by Vincenzo Viviani, Galileo's most notable pupil, who was the incumbent Professor of Mathematics when the Chair was officially transferred from the Studio Fiorentino to the Accademia del Disegno in 1639.[152] At the centre of this revival in artistic principles which were generally Leonardesque in tone and not infrequently inspired directly by Leonardo, was the redoubtable figure of Cassiano del Pozzo.

Under the wing of the powerful Barberini family from the 1620s, Cassiano established himself as one of the chief arbiters of taste in Italy, particularly with respect to the classical heritage. Well-informed on scientific questions, he was a friendly supporter of Galileo, and was elected to the Accademia dei Lincei on his own account in 1622.[153] His remarkable patronage of Poussin would alone single him out for special mention in the history of art, and we may take Poussin's cerebral style as corresponding very closely to Cassiano's own tastes. In 1635 Cassiano himself copied out a version of Leonardo's 'Trattato' with a view to publication, and Poussin was involved in providing some suitable illustrations. Cassiano was the driving force behind the first major attempt to grapple with Leonardo's written legacy in the scientific as well as the artistic field. The eventual outcome was less extensive than he hoped, but his efforts did lead to the French *editio princeps* of 1651, which we have already seen contributing to the debates in Paris.[154]

Cassiano was actively involved in the preservation and dissemination of Zaccolini's treatises and he provided an appreciative account of their contents:

> Matteo Zaccolini of Cesena was endowed by Nature with such a marvellous disposition for painting, particularly for perspectives, that, in spite of his not having undertaken systematic instruction and not having the opportunity to learn the Latin language, . . . he was able on account of his

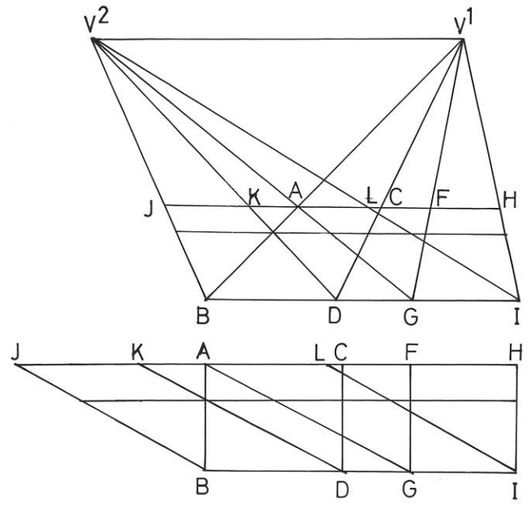


254. Demonstration of the convergence of parallel lines on inclined planes, based on Matteo Zaccolini's 'Prospettiva lineale'.

Parallels from A, B, C and D, and from M, N and X on the inclined plane MB share the 'vanishing point' V.

255. Demonstration of the convergence of two sets of parallels in the same plane, based on Zaccolini's 'Prospettiva lineale'.

The parallels BA, DC, GF, HI perpendicular to the picture plane, share the 'vanishing point' V^1.
The parallels BJ, DK, GA, IL, share the 'vanishing point' V^2.



> vigorous mental aptitude to participate in discussions in the house of Signor Cavaliere Scipione Chiaramonti . . . He began to collect some rules pertaining to the practice of perspective.[155]

Cassiano then lists Zaccolini's sources as Euclid, Witelo, Aristotle, Pecham, Kepler, and most especially Leonardo, and gives a brief description of the four treatises. These are entitled: 'Prospettiva.lineale'; 'Della Descrittione dell'ombre prodotte de' corpi opachi rettilinei'; 'De' Colori'; and 'Prospettiva del colore'.[156] All are highly finished manuscripts with detailed illustrations and were virtually ready for publication. The letter dedicating the treatise on the 'Perspective of Colours' to Scipione Chiaramonte of Cesena, the noble astronomer and man of letters who was his patron, is dated 1622. Zaccolini, who was a lay brother of the Regular Clerics of the Theatine Order, is now virtually unknown as a practising artist, and few of the illusionistic schemes admired by his contemporaries have survived.[157] However, his treatises do much to justify the high regard in which he was held and show a considerable intelligence at work.

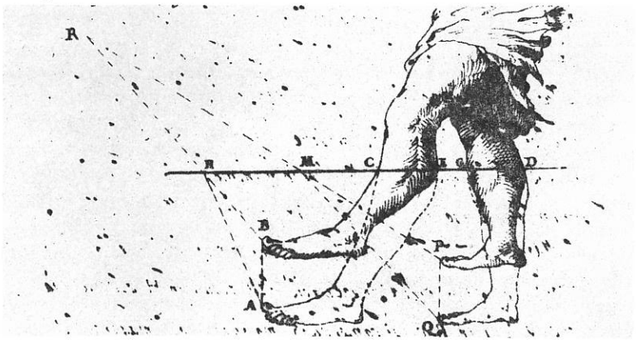
Although Zaccolini is interested in the structure and functioning of the eye, his ideas in this area of optics are unremarkable and incompletely resolved. Rather, his main concerns and abilities lie in the field of geometrical optics and colour theory. His deficient Latin does not appear to have been a serious obstacle to his acquiring a reasonably wide-ranging knowledge of geometrical theory, and he may have been assisted by Chiaramonte in the understanding of otherwise inaccessible texts. We know, for example, that he consulted Guidobaldo's *Perspectivae libri sex*, since it is acknowledged as the source of his methods for drawing ellipses.[158] We can also confirm the essential accuracy of Cassiano's list of sources, although Kepler cannot be seen as a significant influence on any aspect of Zaccolini's optics.

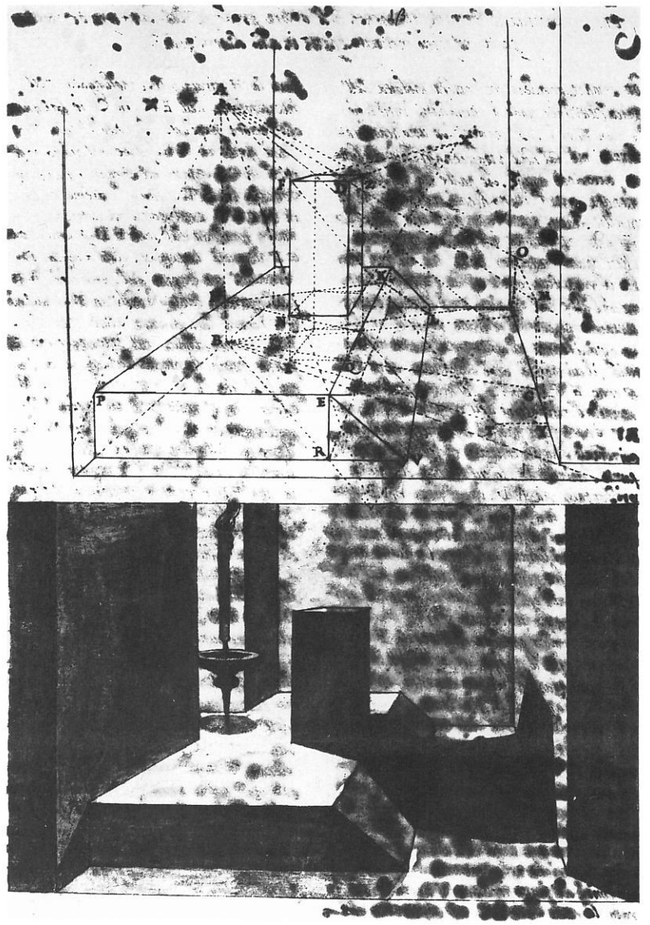
Notwithstanding the expected echoes of Leonardo and other theorists, the content of his treatises has a far higher quotient of originality than is usual in theoretical writings by artists. This originality consists of utilising ideas from his sources in imaginative ways, relating them effectively to his own observations of nature, and devising ingenious diagrams for his demonstrations.

Two of the demonstrations from his treatise on 'Linear Perspective' will give an idea of his approach. The first (pl. 254) shows that parallel lines in two inclined planes will converge to the same vanishing point. The second (pl. 255) shows that two sets of parallels in the same plane will converge to two different points on the horizon. These relate to well-established procedures, but the particular form of the demon-

256. Demonstration of the effects of refraction on the appearance of human legs in water from Zaccolini's 'Prospettiva lineale'.

The toes at points A and Q will be seen at points B and P for an observer at R, looking through the surface of the water MD.





257. Study of cast shadows from Matteo Zaccolini's 'Della Descrittione dell'ombre', *c.*1617–22, Florence, Biblioteca Laurenziana, MS. Ashurnham, 1212, IV, fol. 13v.

strations may have been invented by Zaccolini himself in his typically agile manner. Later in this treatise he displays sufficient knowledge of conic sections to consider questions as 'how to determine the position in which the eye is located so that the given hyperbola will appear to be a portion of a circle'.[159] He is also the first art theorist since Leonardo to give serious sustained attention to the effects of reflection and refraction (pl. 256).

To some extent Zaccolini's unpublished manuscripts, which we will encounter at great length in our later studies of colour, represent eccentric byways in the story we are telling, but we would be wrong to think that they played no role in the mainstream of theory and practice. Not only did Domenichino admit his indebtedness to Zaccolini on questions of perspective, but Poussin also paid close attention to the manuscripts, to the extent that one or more of the treatises was copied specifically for him.[160] He almost certainly owned a copy of the treatise on shadows, which contains the most visually compelling of the illustrations, including complex demonstrations of shadows on different planes cast by geometrical bodies under the illumination of single and multiple sources (pl. 257).[161]

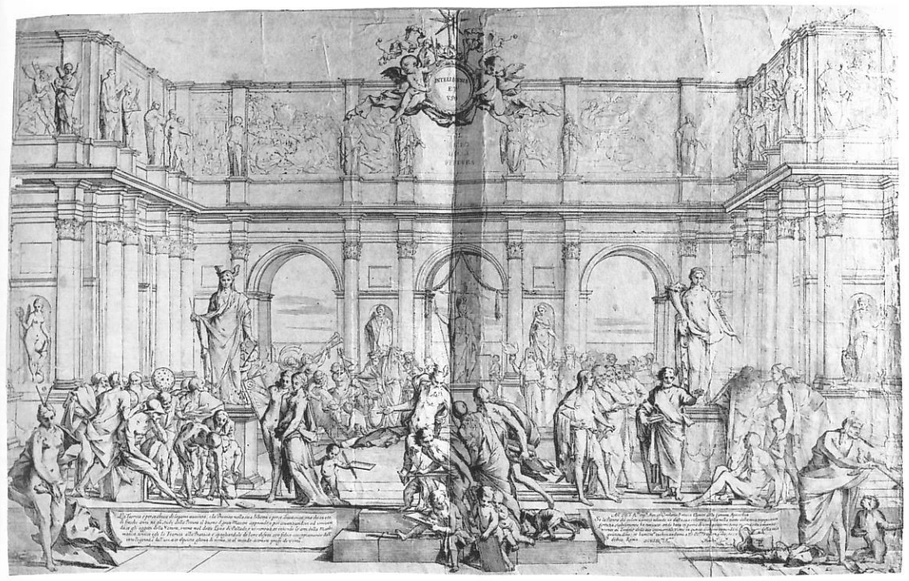
An even more direct reflection of Cassiano's tastes is provided by the writings and prints of Pietro Testa, who was drawn into Cassiano's Roman ambience, with results which do not seem to have been altogether beneficial for Testa's creative health.[162] Testa never organised his thoughts into publishable form, but his surviving notebook in Düsseldorf does present a clear picture of his commitment to rational imitation:

> Painting is a habit that has its foundations in scientific and contingent reasoning; the one has to do with *mores*, decorum and emotions, while the other is concerned with shadows and lights and reflections, with the way forms diminish virtually to a point, how colours diminish in intensity through the weakness of light or from distancing, how colour harmonies are made according to the rules of music and other similar things. Painting remains, so to speak, a cadaver, like a body that has no soul, without these sciences, and, in sum, practice needs to be united with theory.[163]

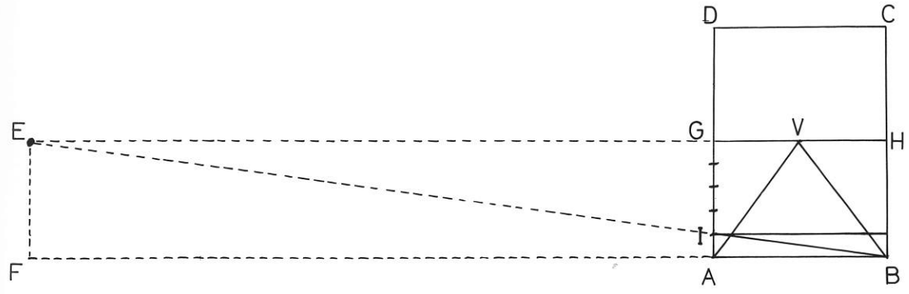
I do not think that Leonardo, Zaccolini or Cassiano would have dissented from this formulation.

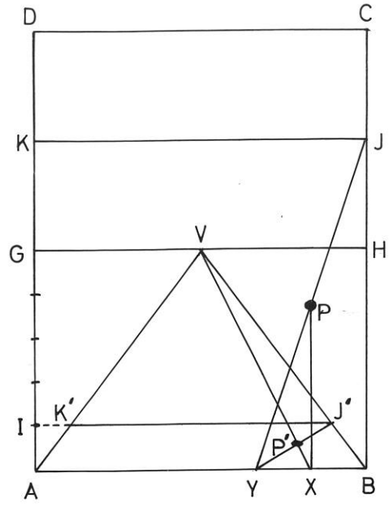
Testa's own science of art is relatively unremarkable if reasonably proficient. His main perspective source appears to have been Barbaro, although he did look to Commandino's translation of Euclid's *Elements* for a list of those subjects which stand with perspective as disciplines founded on applied geometry.[164] His most considerable achievement as a theorising artist was his elaborate print, *Il Liceo della pittura* ('the High School of Painting' [pl. 258]).[165] In an ensemble deliberately reminiscent of Raphael's *School of Athens*, the left side of the composition is peopled by those who represent the abstract joys of mathematics (including the inevitable Euclid, stooping to measure with his compasses), while the right side is dedicated to the application of 'public well-being'. The figures to the right include Aristotle, who stands in the foreground holding one of his books of applied wisdom. The figures below the platform on the extreme left and right graphically make the point that 'practice needs to be united with theory'. Theory, for all her naked perfection and intellectual measure, is found to be incapable of acting, while practice, accompanied by his imitative monkey, gropes blindly without the guidance of higher reason. In the proper pursuance of painting, Testa is declaring, theory and practice are liberated from their bondage to work in fruitful union.

In terms of printed treatises during this period, a comparable stance is adopted by Pietro Accolti, in his *Lo Inganno de gl'occhi, prospettiva pratica* ('The deception of the eye. . .'). Published in Florence in 1625, Accolti's treatise expresses the orthodox standpoint of the Florentine Academy in the Cigoli-Galileo succession. His acknowledged sources—Witelo, Leonardo, Barbaro, Danti-Vignola, Guidobaldo, Aguilonius, etc.—give a clear idea of what kind of book to expect. This is



258. Pietro Testa, *Il Liceo della pittura*, engraving, 1644, London, British Museum.





not to say that he is uncritical of earlier authors. He criticises both Barbaro and Guidobaldo for describing shadows cast only by point sources and not by the sun, whose rays are virtually parallel, as Aguilonius had emphasised.[166] He counsels the painter not to lose colour in the shadows, which tends to happen with the Leonardo method of shading.[167] He makes a knowing reference to the glimmer of reflected light on the shaded side of the moon, a phenomenon explained by Leonardo and more recently by Galileo.[168] And he provides a neat, self-contained method for constructing perspective within the picture field for any viewing distance—a problem which we have seen the French theorists tackling in their own ways.

His constructional method relies on the proportional sectioning of the side of the picture between the base and horizon (pl. 259). The location of any point on the original plan can then be determined in relation to the foreshortened square using diagonal and orthogonal coordinates in a way which seems to be his own variation on the standard constructions (pl. 260).

259. Proportional method of determining perspective diminution based on Pietro Accolti's *Lo Inganno de gl'occhi*, Florence, 1625.

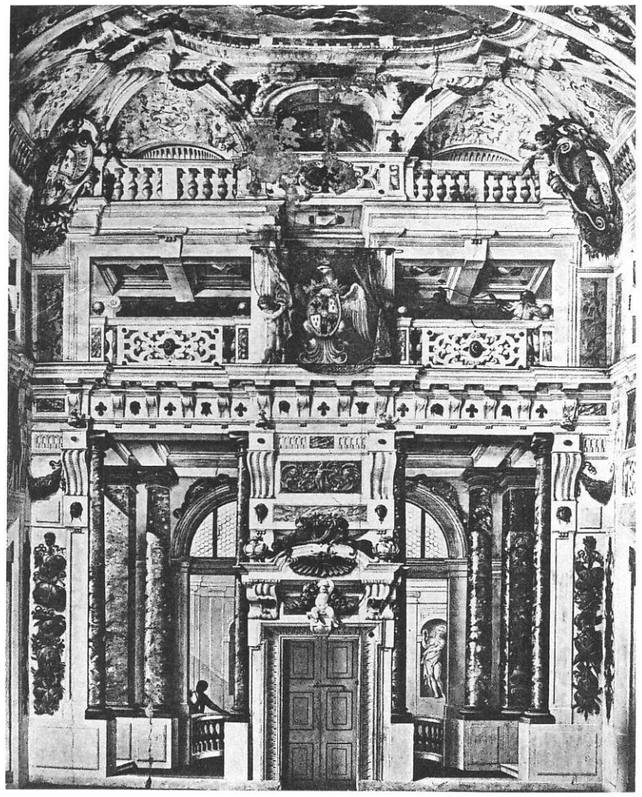
ABCD—picture plane GH—horizon
V—vanishing point

The viewing distance is 4 × the width of the picture.
AG is divided into 5 parts. The first division, I (at a ratio of 1:4 along AG) gives the location for a horizontal at a depth behind the picture plane equivalent to AB.
The construction in dotted lines shows that this is equivalent to the Alberti-Piero methods.

E—observer at 4 units from the intersection AD
B—is seen at I

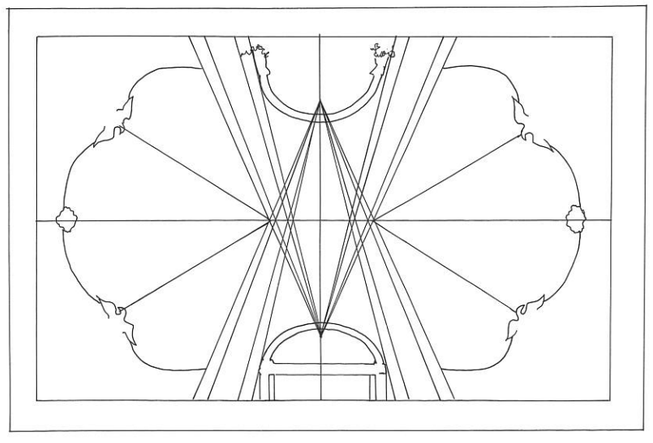
260. Method for the perspectival projection of a given point on a foreshortened plane, based on Accolti's *Lo Inganno de gl'occhi*.

Begin with the construction as above.
ABJK is a square plan on which point P is located.
ABJ¹K¹ is the foreshortened square. Draw JP and extend to Y; draw YJ¹; drop a perpendicular from P to X; draw XV.
The intersection of J¹Y and XV give the location of P in projection at P¹.



261. Michele Angelo Colonna and Agostino Mitelli, *Illusionistic wall decoration*, 1646–7, Sassuolo, Palazzo d'Este.

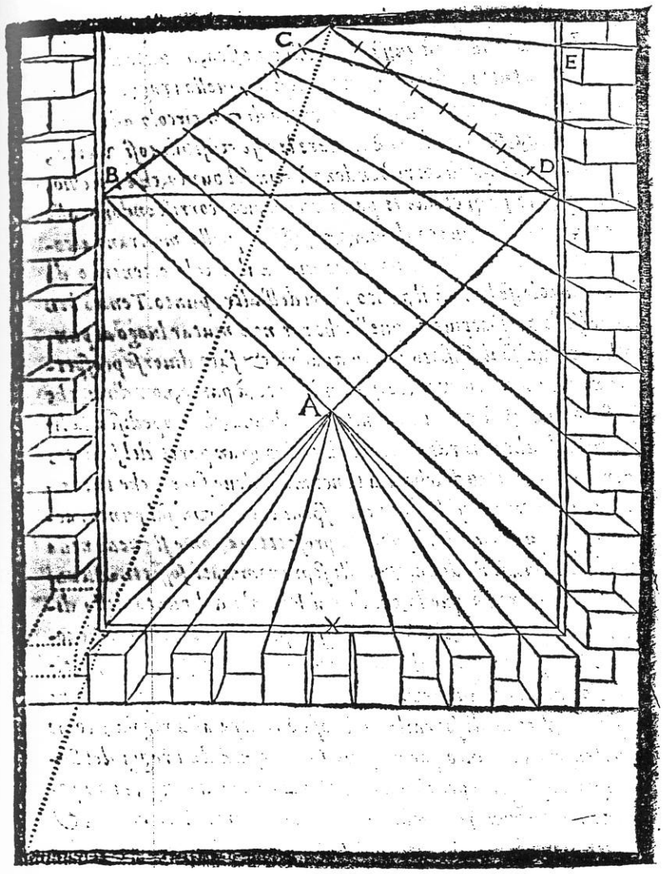
262. Analysis of the perspective in A.M. Colonna's and A. Mitelli's scheme for an illusionistic ceiling (pl. 200).



The results are perhaps rather forbiddingly abstract, but Accolti makes it clear that he does not expect the painter to perform this construction each time in making a picture. By writing his treatise he hopes 'so to open the eyes of contemplators and to inculcate the mind and intellect, that having drunk in these demonstrations and grounded ourselves in these maxims, we will not fear to express freely with the brush those things which I have shown pedagogically through geometry and by means of mathematical demonstrations'.[169] Accolti is in fact much concerned with the reception of his ideas by the students of the Florentine Academy, and the last section of his treatise is devoted to pedagogical advice which is drawn very substantially from the relevant sections of Leonardo's as yet unpublished '*Trattato*'.[170]

When we look at the paintings of the major masters of the 'rational style' during this period, such as Domenichino, Reni and Poussin, we can see the extent to which they followed the spirit of the law, as advocated by Accolti and Testa, without being constrained to follow its letter to the minutest degree. When we turn to the more unsung masters of baroque perspective painting, who were able to meet the continuing taste amongst private and ecclesiastical patrons for elaborate illusionism of the Bolognese variety, we find a pattern of even stronger continuity in optical art between the Renaissance and baroque periods in Italy. New generations of Bolognese artists were prominent in satisfying the continuing demand. The first major successor to the Laureti generation of perspectivists was Girolamo Curti (il Dentone), who incorporated baroque architectural motifs into schemes which obstinately retained the single-point arrangement in which he had been schooled, rather than adopting the looser systems of Annibale Carracci and Pietro da Cortona.[171] It was left to his successors, Angelo Michele Colonna and Agostino Mitelli to effect an accommodation of the Bolognese tradition with the new Roman ideas. Their notably potent partnership generally stands on the fringes of the standard histories of baroque art, but this implied estimate of their marginal importance is belied by their contemporary reputation. Their services were sought in such important centres as Florence itself, where they worked extensively in the Palazzo Pitti, and we have already encountered them serving the King of Spain.[172]

Their partnership was formed in the mid-1630s and continued until Mitelli's death in Spain in 1660. The division of labour seems roughly to have been that Mitelli undertook the technical aspects of the geometrical illusion, while Colonna contributed the *trompe-l'oeil* effects and the figures, but we know that Colonna was an inventive perspectivist on his own account and this division of labour may not have been altogether tidy. The basis on which they constructed their illusions remained the single vanishing-point system, and when they were presented with a surface which could be coherently subjected to a unified presentation they related all the forms to a specific viewing point. A splendid example can be seen in the great hall of the Palazzo d'Este at Sassuolo (pl. 261), the end wall of which provides an elaborate interplay of rectlinear and curvilinear elements with sculpted and 'flesh-and-blood' figures, in a way which corresponds closely to the described



263. Demonstration of a 'softened' system of perspective for illusionistic ceiling decorations, from Gioseffe Viola Zanini's *Della Architettura*, Padua, 1629.

effects in the lost Spanish frescoes. When they were faced with longer or wider pictorial fields in which unified effects tend to become strained, as in the ceiling and long wall of the hall, they adopted more varied systems, in which the foreshortening of the elements is softened, and curved elements are used to work against a definite reading of the illusionistic space. These techniques can be seen in action in the highly-finished oil sketch they made for one of their Spanish ceilings (pl. 200).[173] The ends of the rectangular field have been adorned with rhythmic curves which create a sense of plasticity without a single perspective focus, while the more overtly perspectival motifs which form the centre-pieces on the longer sides are not foreshortened to a central vanishing point but to two lateral points of a more distant kind (pl. 262). The result is an illusion which works by sleight of hand rather than absolute definition.

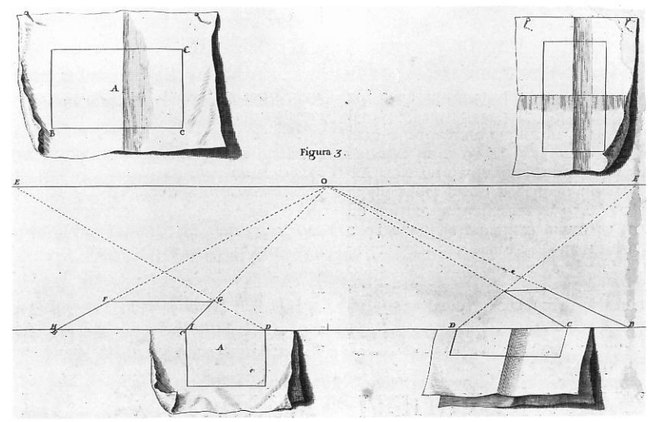
A 'softened' system for long ceilings similar to that developed by Colonna and Mitelli had first been advocated in print by Gioseffe Viola Zanini in 1629.[174] Zanini gives a geometrical method for illusionistic 'softening by the manipulation of the focal point' (pl. 263), an invention he plausibly attributes to the Rosa brothers in Venice, though the loss of their major works makes this impossible to verify.[175] The Colonna-Mitelli approach did not seem to be tied to a fixed formula such as Zanini's, but represented their own flexible combination of the Bolognese geometrical techniques with Annibale Carracci's predominantly non-perspectival illusion of sculptural and pictorial elements in the Farnese ceiling.

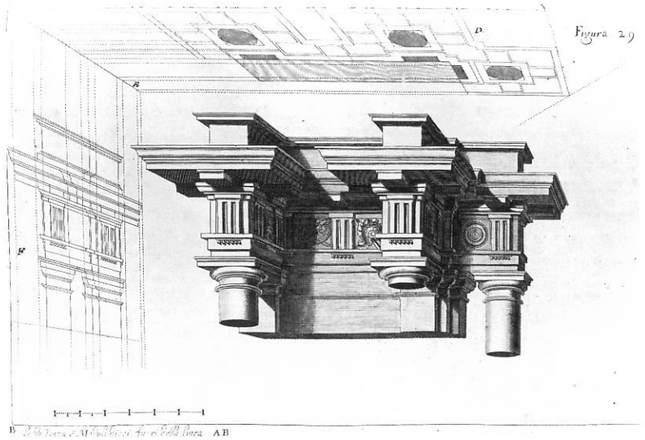
An art such as theirs, which places a primacy on the spectator's unashamed delight in decoration, abundance and illusion, has met with relatively little favour in this century. It would be absurd to claim that their work embodies the profound range of human values to be discovered in the work of a Velázquez or the high intellectual merit of a Piero della Francesca, but equally it would be wrong to underrate the artistic skill and inventiveness involved. We would also be mistaken in thinking that such illusion is necessarily inimical to the conveying of meaning and emotion, though these are not factors which loom large in their particular practice. Others of the baroque illusionists were more involved in taking these expressive factors more fully into account. This is true above all of the greatest of the ecclesiastical perspectivists, Andrea Pozzo, whose frescoes at the Church of S. Ignazio in Rome represent the culmination of developments in religious illusionism which stretch back to Melozzo da Forlì and even to Masaccio in the fifteenth century.

Not only was Pozzo's practice spectacular enough on its own account, but he also published two splendidly illustrated and deservedly popular volumes on his techniques and designs. His *Perspectiva pictorum et architectorum* was published in two parts in 1693 and 1700, with parallel Latin and Italian texts.[176] It was subsequently translated into German, English, French and Dutch. The first volume, which matches alternating pages of plates and text, builds up in a systematic way from his basic demonstration of a distance-point method (pl.

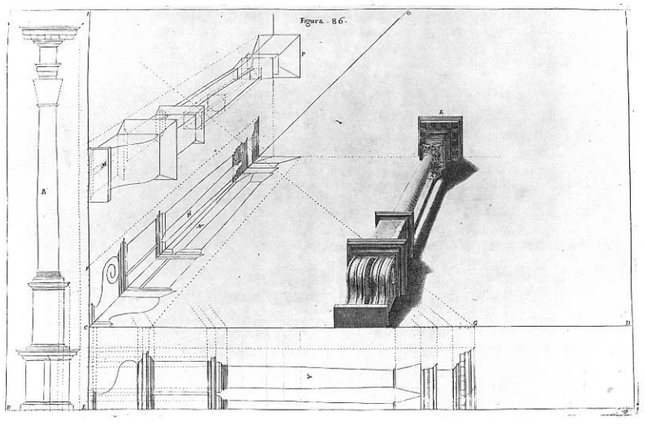
264. Demonstration of the 'distance point' method, from Andrea Pozzo's *Perspectiva pictorum et architectorum*, Rome, 1693.

O—'vanishing point' E, E—'distance points'





265. Perspective representation of elements of the Doric Order, from Pozzo's *Perspectiva*.



266. Use of the 'distance point' method to foreshorten architectural elements for an illusionistic decoration, from Pozzo's *Perspectiva*.

The dotted line from G goes to the distance point (as in pl. 264). The solid line CD goes to the 'vanishing point'.

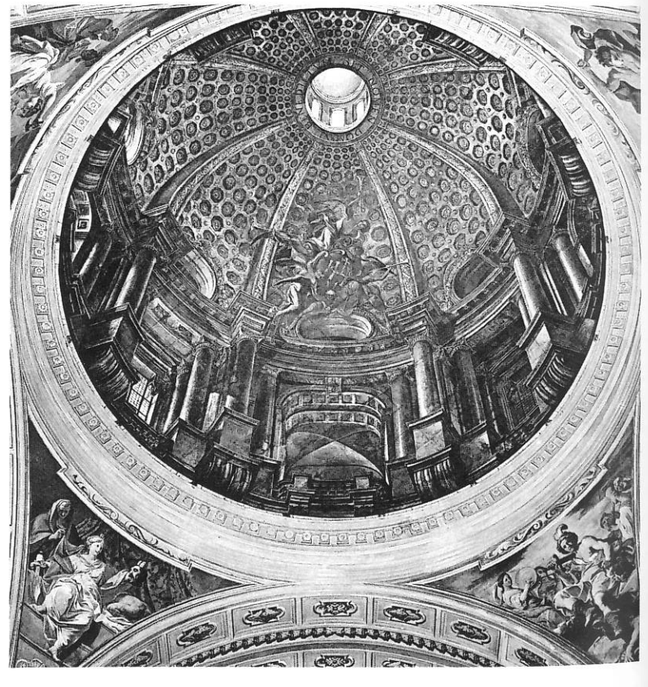
264) to the construction of more complex architectural forms (pl. 265) and eventually to the depiction of complete settings. His demonstrations of 'horizontal perspective' in ceilings (pl. 266), with which he is naturally concerned, retain clear indications of how the basically simple method can be applied to the foreshortening of complex forms.

As an example of what can be achieved he illustrated the illusionistic dome (pl. 267) which he painted in 1685 for S. Ignazio, the third of the great Roman churches of the Jesuit Order in which he was a lay brother.[177] In the years between 1685 and 1694 he was virtually to remodel the interior of S. Ignazio in paint. The dome, cunningly viewed from an off-centre position as we approach it down the nave, is painted on a flat canvas stretched across the aperture of the circular drum.

It serves not only as a piece of sheer visual bravado but also as a quick, light, cost-effective alternative to an actual structure. He amusingly records the kind of controversy his *tour de force* stimulated: 'Some architects disliked my setting advancing columns upon corbels, as being a thing not practised in solid structures; but a certain painter, a friend of mine, removed all their scruples by answering for me, that if at any time the corbels should be so much surcharged with the weight of the columns, as to engender their fall, he was ready to repair the damage at his own cost.'[178]

Three years later, amidst intensive debate, he undertook the much more radical and permanent step of painting the whole of the nave ceiling (pl. 268). The system of architectural perspective he used was deeply uncompromising, and restorted to none of the softened or ambiguous effects that Colonna and Mitelli would have favoured for such an enormous space. The whole of the architectural framework, which dramatically extends the height of the nave towards a radiant heaven, is subordinated to a single-point system. The perfect viewing position in the church is denoted by a disk in the floor. The method Pozzo used to achieve this precision was not essentially new, but he did describe it with notable clarity (pl. 269), and applied it with remarkable control. His perspectival design was first drawn to scale on a sheet of paper, which was divided into squares. A matching grid of strings was suspended across the nave at cornice level. A further string was then used to take 'sightings' through the suspended grid from the viewing posi-

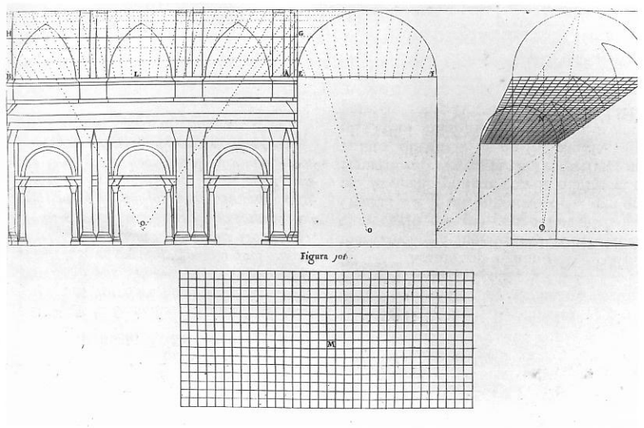
267. Andrea Pozzo, Illusionistic dome, 1685, Rome, S. Ignazio.



268. Andrea Pozzo, *The Transmission of the Divine Spirit*, 1688–94, Rome, S. Ignazio, illusionistic decoration of the nave vault.

269. Demonstration of the use of a grid to project an illusionistic design on to a curved vault, from Pozzo's *Perspectiva*.

O—observer
BLA, EF—grid which is projected on to the curved vault from position O

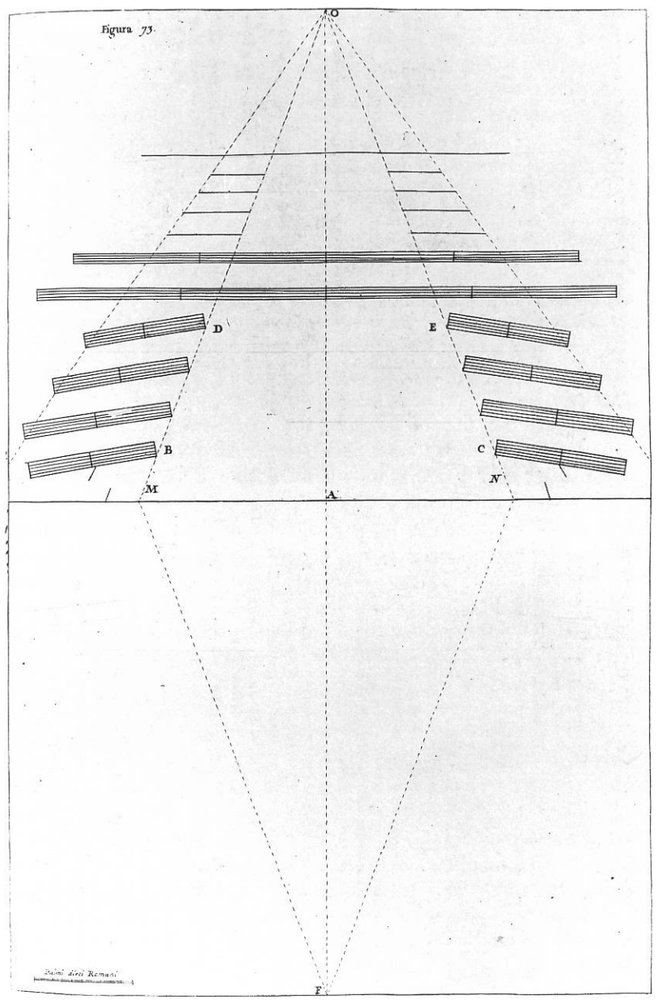


tion, O, in such a way that the grid was projected onto the curved surface of the vault. The design was then transposed line-by-line from the squares of the drawing to the curved equivalents on the ceiling.

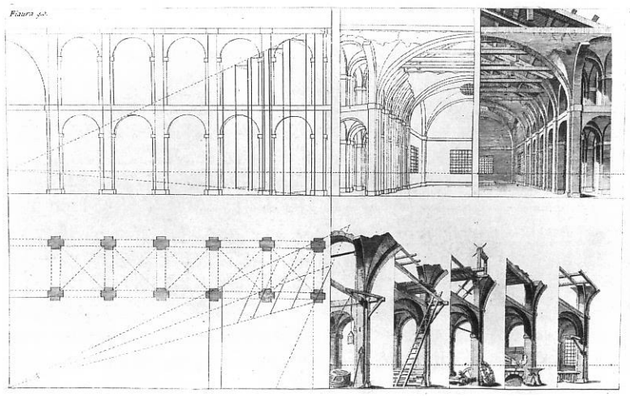
In answer to the inevitable charge that his one-point system is overly rigid and unresponsive to the needs of differently-placed spectators, he marshalls a series of arguments: he claims that all 'the greatest masters' have observed the single-point rule (though he does not go into details); he argues that 'the painter is not obliged to make it appear real when seen from every part, but from one determinate point only'; he criticises multi-point systems, in that they do not look entirely correct from anywhere; and, most interestingly, he asserts that the distorted appearance of the work seen from the wrong position is 'so far from being a fault, that I look on it as an excellency in the work'.[179] The whole point of the illusion, in Pozzo's eyes, is that the distorted chaos of shapes is able miraculously to coalesce into a coherent revelation when viewed from the proper position. I think that 'miraculously' is the operative word in this case. In his preface, Pozzo firmly announced that he intended 'with a resolution to draw all the lines thereof to that true POINT, the Glory of GOD'. In the case of the nave, that 'POINT' is actually the Son of God who, in Pozzo's own words, 'sends forth a ray of light into the heart of Ignatius, which is then transmitted by him to the most distant regions of the four parts of the world'.[180] The whole system of optical dynamics, as it surges to its central focus, serves the radiant core of the vision, and it is from this core that the rays of spiritual energy radiate to the peoples of the world through Jesuit missionaries.

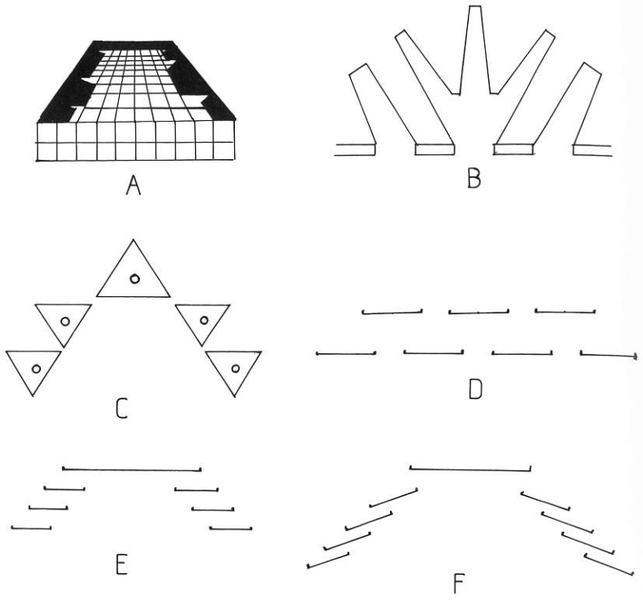
Such placing of illusion in the service of both astonishment and communication breathes a strong air of the theatre, and Pozzo himself is happy to refer to other of his ecclesiastical illusions specifically as 'theatres'.[181] The second volume of his treatise, which deals predominantly with the intersection method, also illustrates a series of examples of Pozzo's skills in ecclesiastical and secular action. In particular he provides detailed instructions about the perspective of stage scenery, using angled flats (pls. 270 and 271). This strong presence of the theatre in Pozzo's theory and practice serves to remind us that one of the greatest reservoirs of perspectival expertise during the seventeenth century was to be found amongst those artists who practised illusionistic stage design.[182] Although this is not the place to undertake a full-scale analysis of scenographic techniques, I think it will be useful to summarise briefly the main developments, since the scene painters' techniques begin to feed back into the art of easel and mural painting, as we will have increasing cause to see.

The simplest form of illusionistic stage design is a perspectival backdrop, and this is what Pellegrino da Udine seems to have used in his innovative design in Ferrara in 1508. The main need, however, was for settings which combined the real but necessarily shallow depth of the stage with an illusion of extended space. From the second decade of the sixteenth century, pioneers such as Baldassare Peruzzi (perhaps himself inspired by Leonardo) had devised various systems of 'accelerated' perspective which operated with a series of lateral ele-



270. Plan of scheme for an illusionistic stage setting, from Pozzo's *Perspectiva*.





272. Various plans for illusionistic stage settings in the manners of (A) Baldassare Peruzzi (based on Serlio), (B) Vincenzo Scamozzi, (C) Egnatio Danti, (D) Jean Dubreuil, (E) Inigo Jones and (F) Andrea Pozzo.

ments variously orientated to the audience (pls. 272 and 120).[183] The type advocated by Pozzo, with angled flats, had the advantage that it permitted laterally placed members of the audience the least chance to see between the elements of scenery, but this system was also the most demanding perspectivally, since the designer needed to compensate for the optical distortion caused by a series of oblique, overlapping planes. The problem is not unlike that faced by a sculptor working in low relief, who has to coordinate the actual and fictive recessions. It is also closely related to the illusionistic effects practised by Bernini and Borromini in actual buildings when they wished to convey the impression of greater depth than the site permitted.[184]

The interplay between scenographic perspective and pictorial techniques became particularly intense towards the end of the century. Indeed I think it is true to say that the last major phase of Italian perspective painting, from Pozzo to Canaletto, cannot be understood without taking the scenographic dimension into account. At the heart of this interaction was the widely influential work of the Bibiena dynasty of scenographic designers, at least eight of whom have definable careers of some substance.

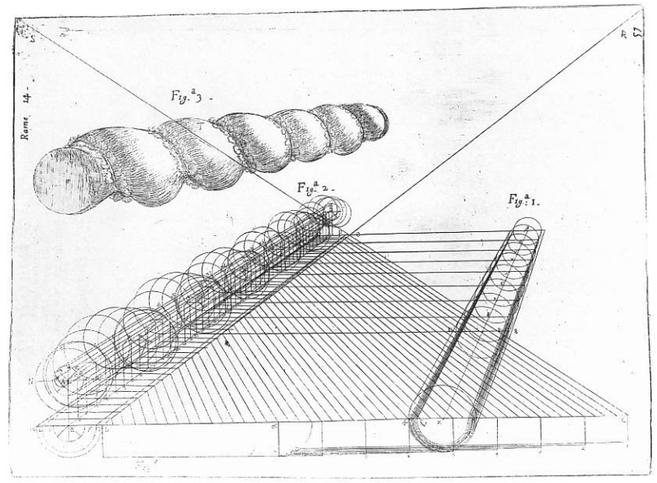
Ferdinando Galli da Bibiena, who was responsible for

271. Scheme for illusionistic stage decoration from Pozzo's *Perspectiva*.

upper left: elevation of the 'building' with flats on the right
lower left: plan of the 'building' with angled flats on the right
upper right: effect from the auditorium
lower right: five lateral flats viewed separately

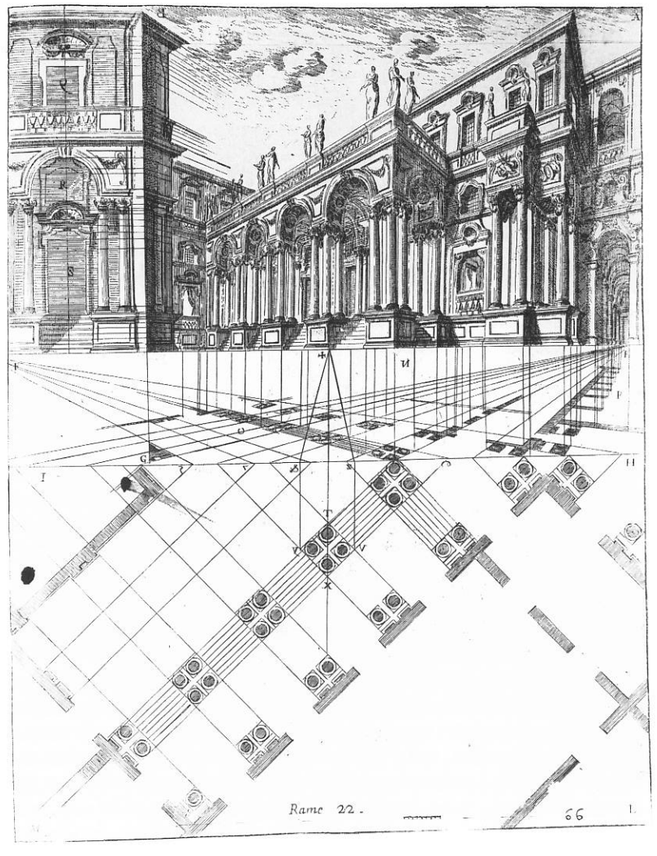
founding the dynasty, owed his training to the Bolognese school of illusionists, and later returned to the city to lend his own skills to the continuance of that tradition.[185] One of his early instructors, Giulio Troili, was the author of a text book on perspective, *Paradossi per pratticare la prospettiva senza saperla* (1672), a treatise which has a certain charm, though, as its title suggests—'perspe ve without understanding it'—not one which demands or reflects a high degree of perspectival erudition.[186] Troili's activities as an author may well have been in Bibiena's mind when he sat down to prepare his own *Architettura civile, preparata su la geometria e ridotta alle prospettive*, which was published in Parma in 1711.[187] The scope of his book, as it progresses through basic geometry to the design of architectural elements and the construction of perspective views, is standard enough, and the basic techniques he effectively illustrates (pl. 273) do not introduce any essentially new principles. Its importance lies in its exposition of the scenographic technique for which the Bibiena became famed across Europe, the *scena per angolo* (pl. 274). The aim of this form of design was the setting of buildings at sharp angles to the audience so that diagonal vistas were opened up. These effects were remarkably created by perspective illusion on a series of flats which were more naturally adapted to the standard forms of illusion. The advantage of the new technique was twofold: it lent itself to the creation of dramatic effects of monumental architecture with varied recessions; and it was rather less vulnerable to distortion from different points in the auditorium. The use of diagonally disposed forms was not, of course, a new idea as such—Brunelleschi's Palazzo de' Signori demonstration, for example, relied on such an arrangement—and earlier scenographers had used diagonal elements; but Ferdinando was the first to exploit the *scena per angolo* in a dominant and compelling manner.

During the latter part of his career in Bologna, Ferdinando became increasingly involved with the Accademia Clementina, and his *Discrezione ai giovani studenti nel disegno dell'architettura civile* in 1731 was designed to provide a pedagogic introduction to his techniques for the young Bolognese artists.[188] In these activities he worked closely with Giampietro Zanotti, the painter-author who was the founder and secretary of the Academy, and its subsequent historian.[189] It is an indication of the continuity of the intellectual context in this Italian academic environment that Giampietro's son, Eustachio Zanotti, should develop into a Newtonian scientist and astronomer of note, who wrote his own treatise on perspective, the *Trattato teorico-pratico di prospettiva* (1766).[190] The nexus within which perspective is situated in Bologna in the middle of the eighteenth century is thus little different in kind from that which obtained in the days of Egnatio Danti. Eustachio Zanotti's treatise, as would be expected from a scientist of his quality, provides an analytical treatment of the mathematics of perspective at a highly professional level but he makes no real concession to the latest ideas about the visual process as such. He is aware that the science of geometrical perspective cannot be regarded as a precise matching of visual experience, and he recommends the avoidance of doctrinaire effects of foreshortening in large-scale schemes to be viewed from various



273. Perspective projection of a twisted column for an illusionistic ceiling design, from Ferdinando Galli da Bibbiena's *Architettura civile*, Bologna, 1711.

274. Scheme for an illusionistic stage setting 'all'angolo', from Bibiena's *Architettura civile*.



275. Giovanni Battista Tiepolo, *The Banquet of Cleopatra*, 1744, Melbourne, National Gallery of Victoria.

angles, but his ultimate recommendation is that the painter can best evoke reality by following the established rules with care and consistency.[191] His own tastes lean towards principles of order and proportional beauty in the classic sense, and he is naturally biased against the freer and more capricious effects practised by some of the later baroque decorators.

Zanotti's conservative, classicising taste is utterly characteristic of a group of scientist-connoisseurs in Italy during the middle years of the eighteenth century in North Italy. Foremost among these, as a European man of letters, as an arbiter of taste and as a patron on his own account, was Count Francesco Algarotti.[192] A great traveller and an energetic correspondent, Algarotti was part of an active circle of intellectuals, patrons and artists who shared similar scientific and aesthetic interests. This circle included the Zanottis; his older colleague Antonio Conti, who pioneered the appreciation of Newton in Italy; Padre Carlo Lodoli, who adopted a radical, rationalist stance in aesthetic matters; and Consul Joseph Smith, the notable promoter of Canaletto, who can hardly be regarded as a man of science yet professed a marked enthusiasm for Newton.[193] Typical of this atmosphere was Algarotti's *Newtonianismo per le dame* ('Newtonianism for the Ladies'!) published in 1737 and translated shortly thereafter into English and French.[194]

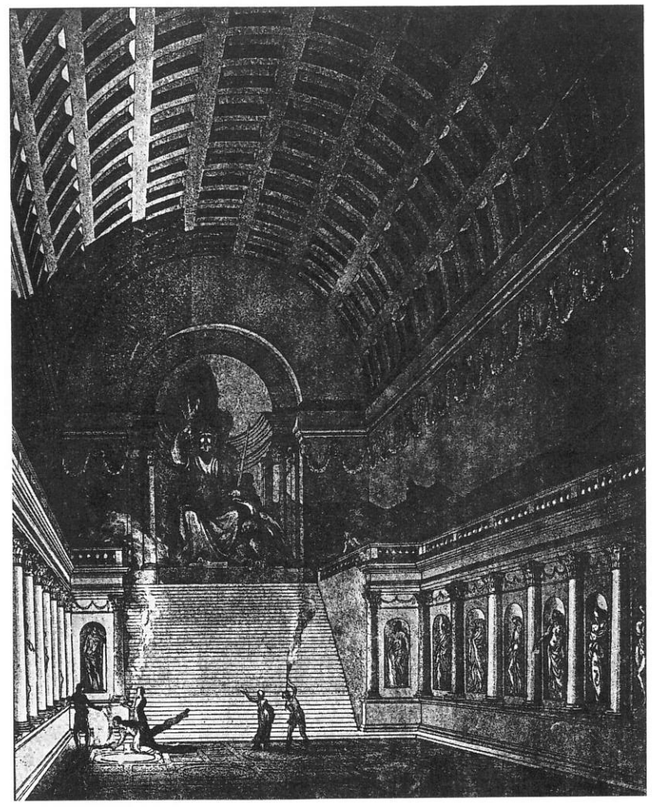
In this lively popularisation of Newton's views on light, we find, as is typical in Algarotti's writings, Raphael rubbing shoulders with Racine, and Newton being paired with Palladio. The general message is that there is a classic canon of order and beauty which is revealed by the greatest art and science, no less by Newton than by the classic painters, sculptors, architects, writers and musicians who had preceded him. Algarotti's Galilean and Newtonian taste for underlying order and logic emerges increasingly clearly in a series of writings which are devoted in whole or in part to the practice of the

visual arts. In addition to the treatise he devoted specifically to painting, which contains a systematic statement of academic orthodoxy, he wrote on architecture, swept broadly across a panorama of the arts, and published a series of letters, a number of which deal specifically with painting, past and present.[195] A typical formulation, from his *Pensieri diversi*, is that 'those who have studied geometry, and other matters equally, make more orderly and conclusive discourses than those who have never been grounded in Euclid'.[196]

Although he resided in his native city, Venice, for relatively short periods of his working life, his impact on the Venetian art world was considerable. The spending power he exercised after 1743 as the agent for Augustus III, Elector of Saxony, no doubt helped him to establish a position as someone with whom to reckon, but he does seem to have been genuinely liked and respected on his own account, not only by fellow patrons and intellectuals but also by the artists, who often had a reputation for being awkward. The major painter with whom he first struck up a productive relationship was the current star of Venetian art, Giovanni Battista Tiepolo. The particular version of the late baroque practised by Tiepolo—a kind of air-filled Rococo—might seem hard to reconcile with what I have said about Algarotti's taste for classical order. However, his appreciation of Tiepolo not only indicates the undogmatic way in which his taste manifested itself in practice, but it also more profoundly reflects the way in which Tiepolo could be read very differently from the manner in which he is generally approached today. For Algarotti, Tiepolo was the true heir of Veronese, the classic master of Venetian space and light in its most high-keyed form.

One of the paintings that Algarotti commissioned for Augustus, the *Banquet of Cleopara* (pl. 275) will help illustrate the qualities he admired in Tiepolo.[197] He himself had acquired the *modello* for the painting, and wrote enthusiastically about the way in which the painter had increased the quotient of classical learning and richness of antique effect in the final version: 'it exhibits the erudition of Raphael or of Poussin'. The whole setting is notably Palladian in feel, and the perspective—as Algarotti did not fail to notice—is more openly paraded for the spectator's admiration than in the earlier scheme. What Algarotti did not notice or record, is that the perspective has been contrived for visual effect rather than for strict spatial logic. Compared to the *modello*, Tiepolo had doubled the number of horizontal intervals, which means that we are no longer dealing with square tiles of clearly determinate plan. If the present tiles are square, the chair and drapery of Mark Anthony would have to span an improbable distance.

In Tiepolo's relationship with the illusionistic decorators who assisted on many of his decorative schemes—the chief of whom was Girolamo Mengozzi-Colonna—the same use of perspective for effect rather than for strict logic is apparent.[198] This certainly did not offend Algarotti, who believed that 'inspiration (*ingegno*) is no less necessary than doctrine; we should bring together equally the vivacity of *fantasia* and the certainty of judgement'.[199] The equilibrium between imagination and rationality mirrors the 'magnificent example of the fabric of



276. Mauro Tesi, *The Temple of Zeus* from *Raccolta di disegni originali di Mauro Tesi estratti da diverse collezioni*, Bologna, 1787.

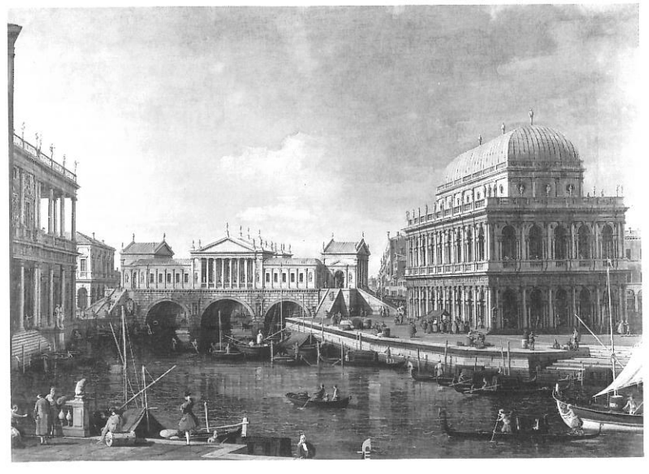
the universe' in which the tangential forces of the planets' motions and the centripetal forces of gravity act in such a fine balance that 'all the system is in equilibrium around the common centre of gravity'.[200] This is typical of Algarotti's version of the science of art; it is less a question of specific prescriptions from science which the painter must rigidly follow, but rather a shared community of philosophical and aesthetic principles which the scientists and artists must mutually respect in their response to the visible world and its underlying order.

Increasingly during the course of his own patronage of artists we find Algarotti adopting a formative role. Nowhere is this more apparent than in the career of his Bolognese protégé, Mauro Tesi. Algarotti was convinced, as were Giampietro and Eustachio Zanotti, that recent Bolognese illusionistic painting had betrayed the great tradition by resorting to proliferations of swags, cartouches, Rococo panels and such like—all of which offended against architectural logic and perspectival lucidity. He even saw the seeds of this decay in the work of the classic masters, Curti, Colonna and Mitelli, who sometimes fell into the easy trap of sumptuous illogicalities.[201] He clearly saw the young Tesi as leading the reform of Bolognese

illusionism under his promotion. He did everything he could to promote Tesi, by word and by deed, and the young man followed a successful if relatively short career as a painter of perspectives and architectural designer. He is virtually unknown today, and his works await proper study. A suite of designs published after his death give a fair idea of his style, and show clear reflections of his study of Bibiena and Piranesi as well as of the older masters such as Serlio and Vignola.[202] The illustrated design (pl. 276), which is closely related to one of the paintings commissioned by Algarotti, will give some idea of the qualities of perspectival conviction and archaeological imagination for which both patron and artist were striving—with some degree of success and with a fair measure of originality.

We can also see the actively shaping characteristics of his patronage at work in his relationship with Canaletto, much of whose art seems to have been rather too literal and non-classical for his taste. On 28 September 1749 Algarotti enthusiastically wrote to Prospero Pesci, the Bolognese painter of architecture and landscape, that he had invented a new genre in which the painter was required to take an existing view and to enrich it with approved buildings.[203] This was, of course, related to the architectural *capriccio*, in which different buildings or elements from different buildings are artificially brought together in a compound scene. This type of picture as practised most notably in Rome by Pannini—one of whose paintings of the Pantheon was owned by Algarotti—was enjoying a considerable vogue at this time. However, Algarotti's invention was subtly different from the standard *capriccio* in that an actual, given location provided the fixed base for the improvisation. 'In this way', he tells Pesci, 'it is possible to arrive at a union of nature and art.'[204] The painting he describes as effecting this union was the view he commissioned from Canaletto of the Grand Canal at the Rialto in Venice (pl. 277).[205] The bridge has been flanked by two of Palladio's

277. Antonio Canaletto, *The Rialto, Venice, Embellished with Palladian Bridge and Palaces*, *c.*1749, Parma, Galleria.



278. Antonio Canaletto, *The Campo di SS. Giovanni e Paolo*, *c.*1735–8, Collection of her Majesty The Queen.

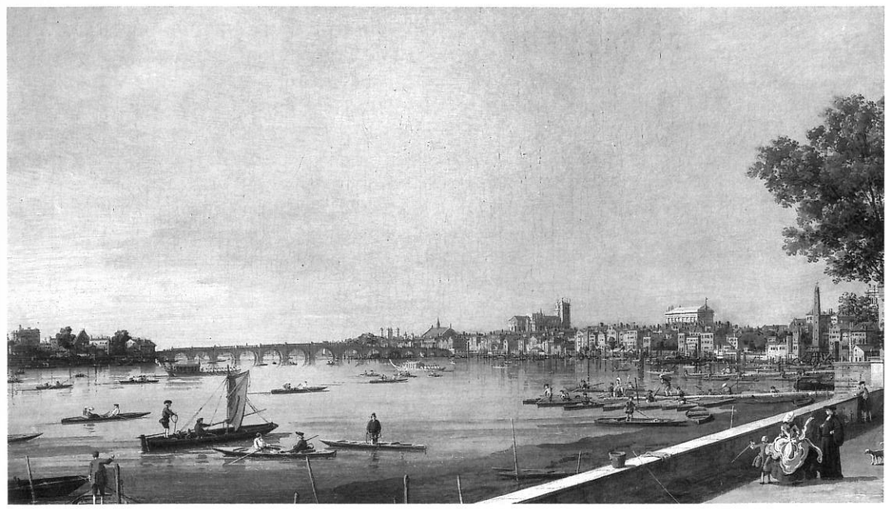
masterpieces from Vicenza and is itself based on Palladio's unexecuted scheme for a new bridge at the Rialto. The delightful compound of mathematics (Palladio's proportional designs and Canaletto's perspective), reality and imagination maintains the kind of aesthetic equilibrium between order and invention which stands at the heart of Algarotti's attitudes in art and science.

The growing bands of *vedutisti* (view painters) at this time, above all in Venice, where Canaletto was the dominant figure, represent what may be regarded as the last major phase of the perspective tradition in Italian painting. The *veduta* may not unreasonably be regarded as a fusion of the Northern genre of perspective townscapes—one of the leading early practitioners was Gaspar van Wittel (Vanvitelli) who brought his Dutch training to bear on the Italian scene—with the native Italian tradition of perspectival architecture, particularly in scenographic design.[206] Canaletto's father, Bernardo, practised as a scene painter, and father and son worked together on the sets for an opera by Scarlatti in Rome in 1720.[207] Although Canaletto's paintings avoid the dramatic implications of the *scena per angolo*, as adopted by Piranesi from the Bibiena and Juvarra, the way he presents architecture and space in many of his paintings is deeply imbued with the principles of scenic design. The squares of Venice—the Piazza San Marco and its lesser urban *campi* (pl. 278)—become stage sets in which everyone may play a role, however small and fleeting.[208]

Canaletto's paintings and drawings bear witness to the enormous effort of constructional precision which went into the geometrical control of foreshortened and unforeshortened elements.[209] The compass, the divider and the ruler were essential tools for him. His greatest paintings achieve an extraordinary control over the viewer's eye. Look, for example, at the way he draws our gaze towards the narrow, main exit from the Campo si SS. Giovanni et Paolo. He does this by means of the perspective and the diagonal light, while at the same time our orientation to the diagonal path which leads to the front of the church creates a secondary or 'accidental' *punctum concursus* of no little importance. These effects are clearly

279. Antonio Canaletto, *The Thames from the Terrace of Somerset House Looking Towards the City (i.e. East)*, *c.*1750, New Haven, Yale Center for British Art.

280. Antonio Canaletto, *The Thames from the Terrace of Somerset House Looking Towards Westminster (i.e. West)*, *c.*1750, New Haven, Yale Center for British Art.



281. Antonio Canaletto, *The Thames from the Terrace of Somerset House Looking Towards Westminster (i.e. West)*, *c.*1750, New Haven, Yale Center for British Art.