

1. *The Critic Sees*, by  
Jasper Johns, 1961.

1986

Translations from Drawing to Building



To translate is to convey. It is to move something without altering it.<sup>1</sup> This is its original meaning and this is what happens in translatable motion. Such too, by analogy with translatable motion, the translation of languages. Yet the substratum across which the sense of words is translated from language to language does not appear to have the requisite evenness and continuity; things can get bent, broken or lost on the way. The assumption that there is a uniform space through which meaning may glide without modulation is more than just a naïve delusion, however. Only by assuming its pure and unconditional existence in the first place can any precise knowledge of the pattern of deviations from this imaginary condition be gained.

I would like to suggest that something similar occurs in architecture between the drawing and the building, and that a similar suspension of critical disbelief is necessary in order to enable architects to perform their task at all. I would like to suggest also that, while such an enabling fiction may be made explicit, this has not been done in architecture, and that because of this inexplicitness a curious situation has come to pass in which, while on the one hand the drawing might be vastly overvalued, on the other the *properties* of drawing – its peculiar powers in relation to its putative subject, the building – are hardly recognized at all. Recognition of the drawing's power as a medium turns out, unexpectedly, to be recognition of the drawing's distinctness from and unlikeness to the thing that is represented, rather than its likeness to it, which is neither as paradoxical nor as dissociative as it may seem.

154 Before embarking on the investigation of drawing's role in architecture, a few more words might be spent on language; more particularly, on the common antilogy that would have architecture be like language but also independent of it. All things with conceptual dimension are like language, as all grey things are like elephants. A great deal in architecture may be language-like without being language. Some might say that the recent insistence that

architecture is a language is only the last wave of a persistent verbal tide eroding vision, bedevilling our ability to see without language to guide our eyes (Fig. 1). In the words of the poet Paul Valéry, used as the title of a recent biography of an American artist, 'seeing is forgetting the name of the thing one sees'.<sup>2</sup> Can we really be certain? Might not this purism be in danger of becoming a ridiculous piety? Having recognized that words effect vision, we are under no moral obligation to expel them from it, even if the expulsion could be achieved. It is understandable that, in the interest of the integrity of our art, we should imagine it contaminated by other forms of communication, just as it is understandable that, in the interest of its aggrandizement, we should imagine it comparable to language. But this is only to offer excuses for the possession of incompatible ideas.

Fastidiousness about the purity of vision arises from a fear that all distinction will be lost as one category forces itself into another. We protect it because we think it in danger of being overwhelmed by a more powerful agency. With our minds fixed on the predominance of language we might even risk enclosing architecture within its own compound, denying it communication with anything else to preserve its integrity. This would be possible, yet it seems very unlikely to occur because, for architecture, even in the solitude of pretended autonomy, there is one unfailing communicant, and that is the drawing.

155 Some English art historians have been directing attention to the transactions between language and the visual arts: Michael Baxandall with the early Italian humanists,<sup>3</sup> T.J. Clark with French nineteenth-century painting,<sup>4</sup> and Norman Bryson with seventeenth- and eighteenth-century French painting.<sup>5</sup> Their studies, which have advanced art history into an area never properly investigated, show painters and commentators trying to extricate painting from language or trying to accommodate to it, in what was not so much a war between the verbal and the visible as



an economy between them, full of friction though the deals back and forth may have been. I have found their work invaluable and stimulating. It seems to me, however, that this economy dominated by the trade between two powers cannot be transferred to the study of architecture without adaption, for the architectural drawing constitutes a third force that may well equal those of the artwork and its commentaries.

My own suspicion of the enormous generative part played by architectural drawing stems from a brief period of teaching in an art college.<sup>6</sup> Bringing with me the conviction that architecture and the visual arts were closely allied, I was soon struck by what seemed at the time the peculiar disadvantage under which architects labour, never working directly with the object of their thought, always working at it through some intervening medium, almost always the drawing, while painters and sculptors, who might spend some time on preliminary sketches and maquettes, all ended up working on the thing itself which, naturally, absorbed most of their attention and effort. I still cannot understand, in retrospect, why the implications of this simple observation had never been brought home to me before. The sketch and maquette are much closer to painting and sculpture than a drawing is to a building, and the process of development – the formulation – is rarely brought to a conclusion within these preliminary studies. Nearly always the most intense activity is the construction and manipulation of the final artefact, the purpose of preliminary studies being to give sufficient definition for final work to begin, not to provide a complete determination in advance, as in architectural drawing. The resulting displacement of effort and indirectness of access still seem to me to be distinguishing features of conventional architecture considered as a visual art, but whether always and necessarily disadvantageous is another question.

156 Two divergent definitions of the possibilities for architecture follow from the recognition of this displacement. We may choose to

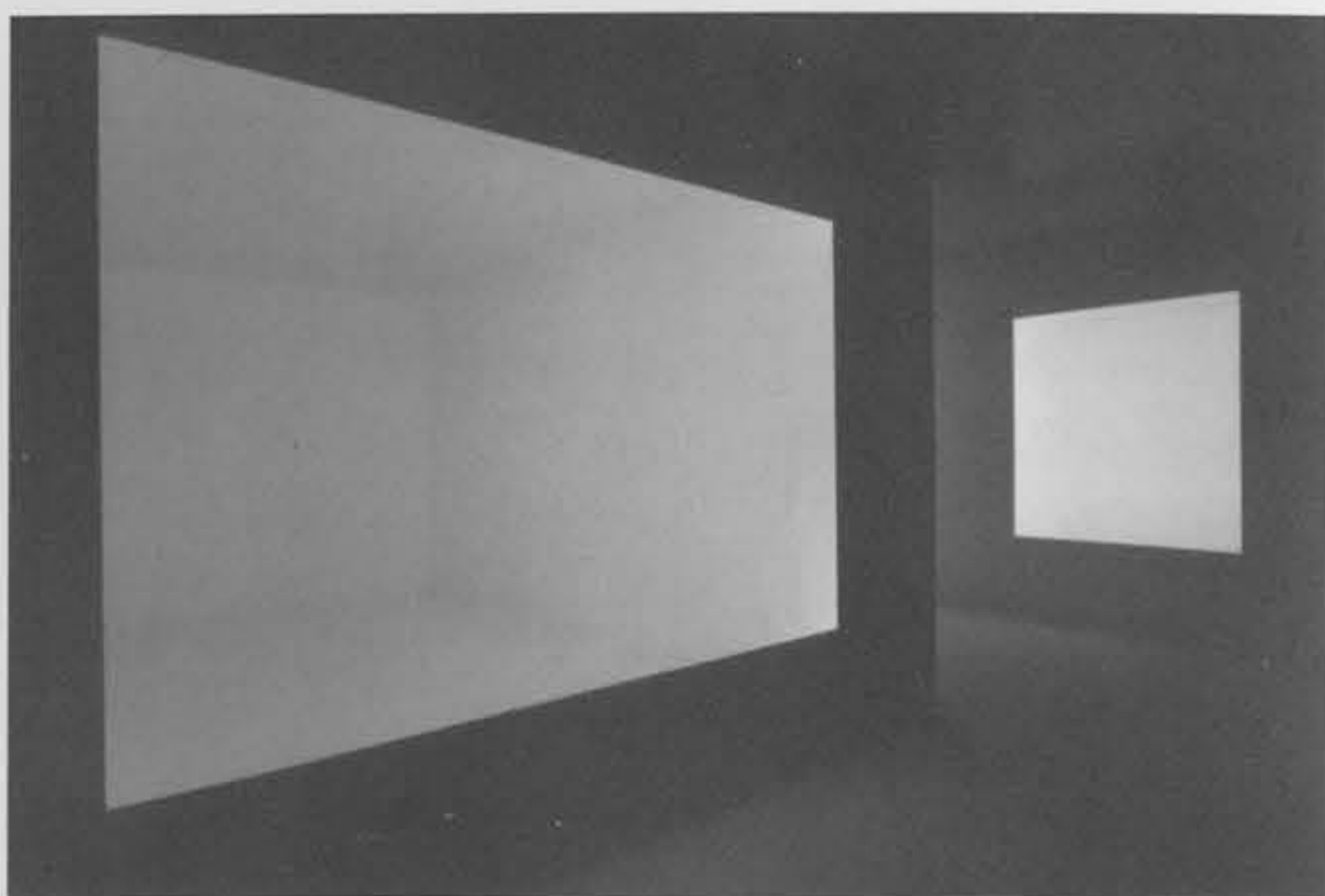
join architecture to the other visual arts more securely by insisting that only that which the architect manipulates with his own hands is his work. It is all too clear that this new intimacy would first require a divorce because, as we gained more direct access to *the work*, we would be relinquishing claim to the architecture that now flourishes within the political, economic and social order. If architecture were redefined in this way, it might become more scrupulous and less responsible, smaller and less predictable, worth less but better, as the hope would be, would it not, that in giving up grandiose pretensions to represent and define the social world in both its imaginative and active aspects (a project the unlikelihood of which is comparable to the unlikelihood of compiling a legal code that is also a good novel – an ambition that can only be confounded in practice) architecture may, by contraction and concentration, constitute itself anew? Well, this consolidation through withdrawal is already under way, and the problem is that it has become exactly this: a consolidation, a restoration, a simple relocation of investment within the region staked out long ago as belonging to architecture.

What might have occurred in architecture, but did not, occurred outside it, and indeed outside painting and sculpture, in so far as these are categorically defined.<sup>7</sup> To insist on direct access to the work may only be to designate the drawing as the real repository of architectural art. It may also be to reject drawing out of hand.

Of the works beyond the pale of architecture – earth art, performance, installations, constructions – which nevertheless deal with recognizably architectural themes, several are remarkable not just for the fact that they make little or no use of drawing, but for the *impossibility* of their development through this medium.

The work of the Los Angeles artist James Turrell may be used as an instance.<sup>8</sup> The mainstay of Turrell's work through the late 1960s and 1970s was the artificially lit room (Fig. 2). Most architectural of these were a series of empty spaces which, if drawn up





2. Installations at Capp Street Project (left: *Orca*, right: *Kono*), San Francisco, by James Turrell, 1984.

within current architectural conventions, could only be construed as indicative of witless simplicity. Their effect as installations can none the less be completely overwhelming. Such directly apprehensible qualities as they possess have nothing to do with the presence of the artist's hands, feelings or personality. Fabricated as they are with tremendous precision and parsimony, there is no more trace of Turrell in these rooms than of Mies in the most sparse of Miesian interiors. Evoking gushes of transcendental mystification from some critics,<sup>9</sup> Turrell's work is, all the same, quite easy to understand and appreciate since it has to do with observers not being able to believe their own eyes. You look into something which you know is another rectangular room with batteries of fluorescent tubes on the back of the partition through which you peer. You can see how it works. You can put your hands into it. You can even see, standing out against the haze of illumination that moves from mauve through to pink, evidence of some earlier investigator who took it into his head to climb into the illusion,

leaving his footprints in the otherwise spotless, spaceless interior.

Even then, only by deduction can you maintain either the depth of the room or the emptiness of it, for the light looks, if not solid, then incredibly dense, as if its luminosity would not so much reveal the image of anything thrust into it as devour it. Take a few steps back and it is impossible to envisage its depth even by an act of conscious will, a few more and the screen-like aperture through which you looked seems to be standing out as a block of light in blatant contravention of what you know to be true.<sup>10</sup> The most remarkable properties of Turrell's installations are local and not transportable. The result of direct observation of the play of electric light on white-painted surfaces and countless experiments *in situ*, they cannot be adequately illustrated or photographed after their construction, and there is no way that even the vaguest hint of their effect could have originated through drawing. In this respect Turrell's illuminated spaces of the 1970s and 1980s – *Orca*, *Raemar*, the *Wedgewood* series, etc. – were further removed from drawing and the drawable than the earlier works in which shapes of light were projected onto walls through cut templates. Turrell made and published (and sold) preliminary drawings for some of these. One cannot imagine such drawings making any sense in the later works. By continuing in the same medium while eliminating the projector, Turrell was effectively taking his work outside the range of the drawing, for it was their projected shape that made works like *Afrum* drawable (Fig. 3).

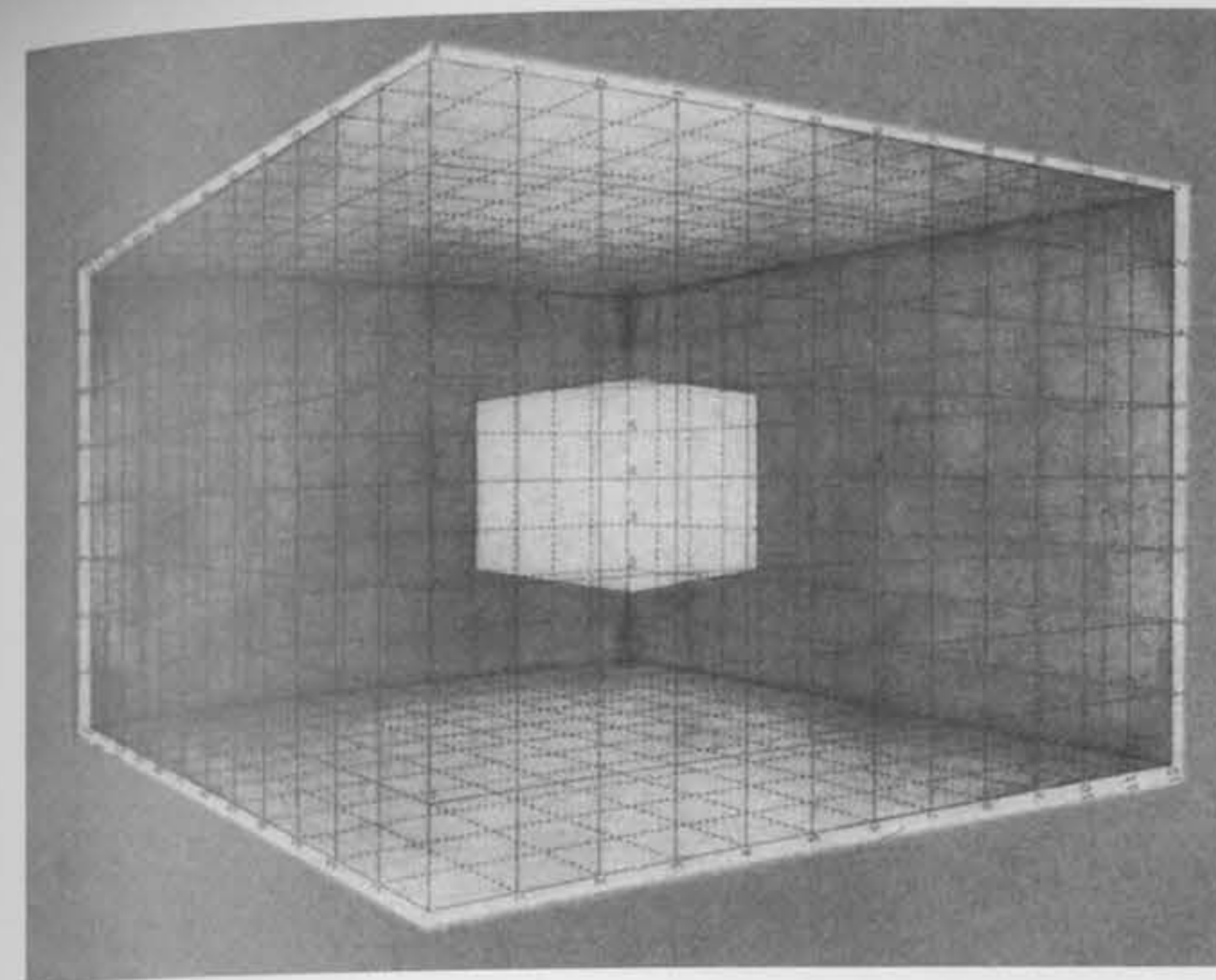
The drawing has intrinsic limitations of reference. Not all things architectural (and Turrell's rooms are surely architectural) can be arrived at through drawing. There must also be a penumbra of qualities that might only be seen darkly and with great difficulty through it. If judgement is that these qualities in and around the shadow line are more interesting than those laid forth clearly in drawing, then such drawing should be abandoned, and another way of working instituted.



Returning momentarily to the recently vaunted status of architectural drawing within the schools: to regard a drawing as a work of art as we usually understand it is to regard it as something to be consumed by the viewer, so that his rapacious appetite for formulated experience may be assuaged. Any further use attributable to it is incidental and detrimental in so far as it may reduce its value as food for consciousness. We have witnessed, over the past fifteen years, what we think of as a rediscovery of the architectural drawing. This rediscovery has made drawings more consumable, but this consumability has most often been achieved by redefining their representational role as similar to that of early twentieth-century paintings, in the sense of being less concerned with their relation to what they represent than with their own constitution. And so the drawings themselves have become the repositories of effects and the focus of attention, while the transmutation that occurs between drawing and building remains to a large extent an enigma.

The second possibility flows directly from this. If one way of altering the definition of architecture is to insist on the architect's direct involvement, either calling the drawing 'art' or pushing it aside in favour of unmediated construction, the other would be to use the transitive, commutative properties of the drawing to better effect. This latter option – which I call the unpopular option – I wish to discuss in this article.

The two options, one emphasizing the corporeal properties of things made, the other concentrating on the disembodied properties in the drawing, are diametrically opposed: in the one corner, involvement, substantiality, tangibility, presence, immediacy, direct action; in the other, disengagement, obliqueness, abstraction, mediation and action at a distance. They are opposed but not necessarily incompatible. It may be that, just as some fifteenth-century painters (Masaccio, Piero, Mantegna, Pinturicchio, Leonardo) combined the pithy irregularities of naturalism with the compositional regularities of perspective construction, so architects might con-



3. Preparatory drawing for *Afrum*, by James Turrell, 1967.

ceivably combine, in such a way as to enhance both, the abstract and the corporeal aspects of their work. Instead, they stand next to each other, in an unpropitious sort of way, as alternative candidates. Argumentative opposition is usually stifling. A tug of war works better between rugby teams than between opposed concepts or practices, yet this is the way we insist on playing games. I would like to avoid this partisanship, so much more effective in drowning out sense than articulating it, but it should be said that in the present climate the tendency is generally to place the abstract and the instrumental within the orbit of a suspect, culpable professionalism, allowing the direct and experiential presence only within a covert architecture which can never be revealed fully in the former, and which shows up as so many sporadic episodes of resistance. In consequence the direct and experiential appears far more ethical and far more interesting, far more at risk and far more real than the indirect and abstract approach. This can only be acknowledged as true to the degree that the varieties of indirectness, abstraction and



5. *The Origin of Painting*, by  
Karl F. Schinkel, 1830.



4. *The Origin of Painting*, by  
David Allan, 1773.



instrumentality found in practice are puerile, obstructive and dull, which on the whole they are, as also are the artistic pretensions of the schools. A contest between two kinds of dullness cannot be expected to come to much, even if it does ensure fairness.

A distinction might be made between the object of drawing as practised in architecture and drawing as practised traditionally in Western art. A story of the origin of drawing, derived from Pliny the Elder<sup>11</sup> and recycled into the visual arts as subject-matter in the eighteenth century (like all stories of origins, far more revealing of the time of its telling than of the time of which it tells), shows this up nicely. The story is of Diboutades tracing the shadow of her departing lover. If we compare versions by two neo-classical artists, one exclusively a painter, the other better known as an architect, some indicative differences become apparent.

David Allan's *The Origin of Painting* of 1773 (Fig. 4) shows the couple in an interior, the dressed stone wall of which provides a plane surface upon which Diboutades traces the shadow made by an oil lamp, placed at the same level as the sitter's head, on a ledge close at hand. Karl F. Schinkel's unusual variation on this theme was painted in 1830 (Fig. 5). Significantly, and in contrast to most other treatments (as well as departing from Pliny), the architect chose, not an architectural interior for his reconstruction of the event, but a pastoral scene with shepherds and shepherdesses.<sup>12</sup> In place of the worked surface of stone, a naturally exposed face of rock. In place of the lamp, the light of the sun. Both paintings, true to the original story, show drawing as a function of projection, and both show quite clearly the combination of elements required: a source of light, a subject upon which it plays, a surface behind the subject, and something to trace with. Schinkel, however, shows the minimum of material artifice needed to accomplish this. To judge from his painting, the first human mark put on nature might well have



been the line of charcoal on the rock, while in Allan's the accoutrements of civilization were already in place to provide the necessary circumstances for this late, charming and reflective accessory. So it is perhaps equally pertinent that, while Diboutades herself performs the task in Allan's painting, it has been delegated to a muscular shepherd in Schinkel's.

The artifice shown by Schinkel is that of an already organized social structure of deference in which is expressed also the distinction between thought and labour, a distinction absent in the more intimate surroundings of Allan's painting. In Schinkel's version drawing precedes building, in Allan's it follows from it. Of the two, it was the architect who was obliged to show the first drawing in a pre-architectural setting, because without drawing there could be no architecture, at least no classical architecture constructed on the lines of geometrical definition. In Schinkel's work, drawing is, from the beginning, a divided activity, resolvable into a prior act of thought and a consequent manual undertaking which the arrival of architecture would duplicate, on a much larger scale, as the difference between design and construction. In this instance the man is servant to the woman: she conceives; he does.

At least as important in the symptomatology is the manner of lighting. Allan uses a lamp, that is, a local, point source of illumination from which issue divergent rays. Schinkel uses the sun, that is, a source so remote that its rays have to be regarded as travelling parallel to one another past the earth. The two kinds of light correspond to the two types of projection, based on divergent projectors, which played a crucial part in painting through the development of perspective; and parallel projection, based on parallel projectors, which has played an equally crucial, though far less well-recognized role in architecture through the development of orthographic projection. The painter's version less remote, more intimate, less differentiated; the architect's more remote, public, insistent on differentiation. Just as we would expect, perhaps, but

the specific expression of these tendencies in Schinkel betrays a professional proclivity, giving drawing a priority, potency and generality not evident in Allan's rendition.

The most notable difference of all, however, is registered only in an oblique way in the two paintings. This has to do with the subject-matter of the artist's work. In painting, until well into the twentieth century, the subject was always, as in the story of Diboutades, taken from nature. It may have suffered vast idealization, distortion or transmogrification, but the subject, or something like it, is held to exist prior to its representation. This is not true of architecture, which is brought into existence through drawing. The subject-matter (the building or space) will exist *after* the drawing, not before it. I could list various riders and qualifications to this principle, which may be called the principle of *reversed directionality* in drawing, to show that it may occasionally be complicated, but these would not alter the fact that, statistically speaking, if I may put it that way, it gives a good account. We might surmise, then, that the absence of an architectural setting in Schinkel's painting is a recognition of this reversal, by which the drawing must come before the building, of so little consequence to Allan the painter, who follows Pliny, innocently imagining that architecture developed to classical maturity without its aid.

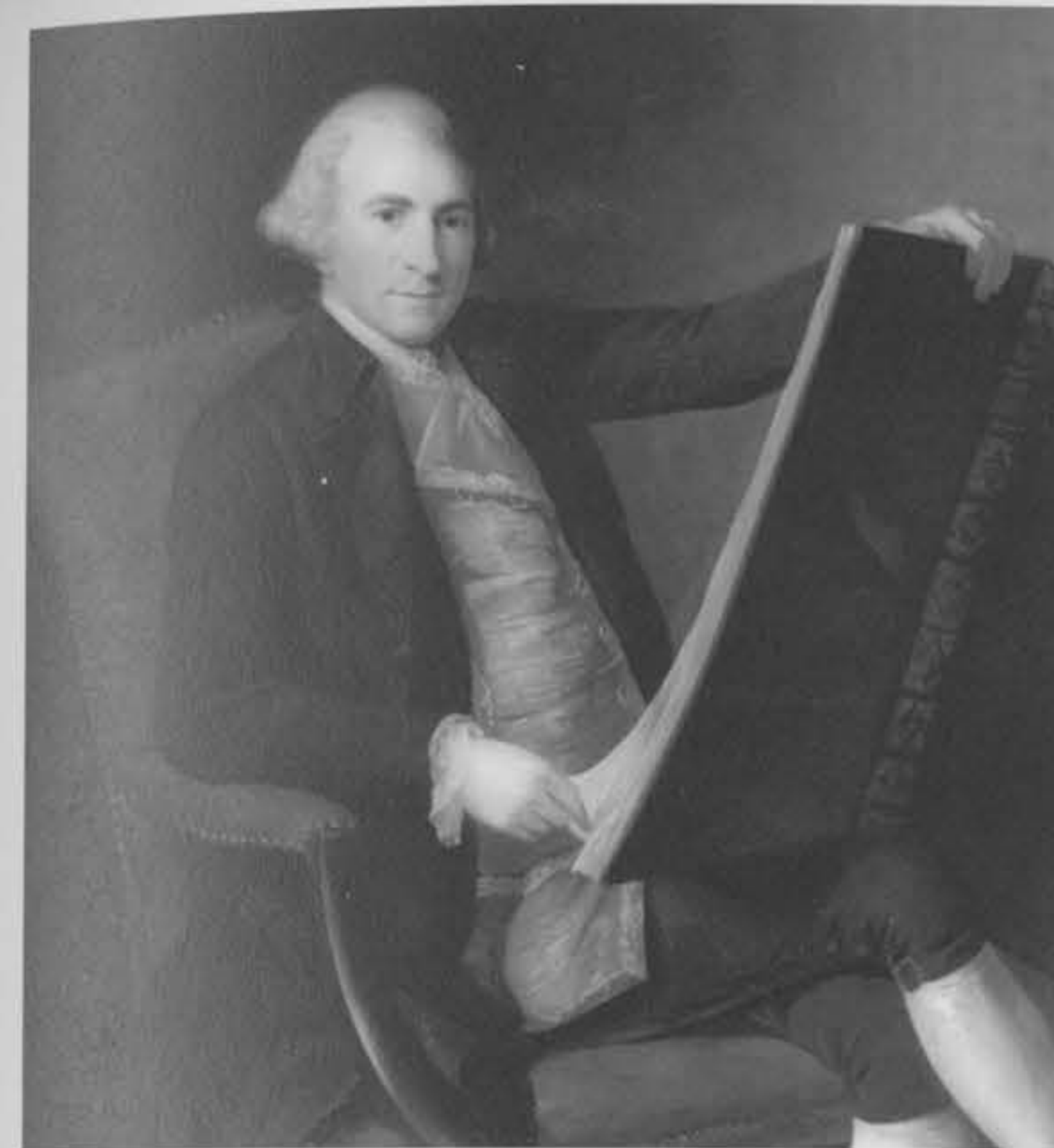
Drawing in architecture is not done after nature, but prior to construction; it is not so much produced by reflection on the reality outside the drawing, as productive of a reality that will end up outside the drawing. The logic of classical realism is stood on its head, and it is through this inversion that architectural drawing has obtained an enormous and largely unacknowledged generative power: by stealth. For, when I say unacknowledged, I mean unacknowledged in principles and theory. Drawing's hegemony over the architectural object has never really been challenged. All that has been understood is its distance from what it represents, hence its periodic renunciation ever since Philip Webb rejected the whims



of paper architecture – while continuing to draw prodigiously.<sup>13</sup> There are all sorts of curious reminders as to the subliminal acceptance, beneath the level of words, of its singular priority within the art of architecture, if art it be, such as in architectural portraits, where, as a rule with but few exceptions, and as in Willison's portrait of Robert Adam (Fig. 6), they are portrayed with their drawings, as are sculptors with their sculptures and painters with their canvases, estranged, for posterity, from the results of their labour, the clients more usually retaining the privilege of being portrayed with the building.<sup>14</sup>

It would take much more than an article to reveal the full extent of drawing's intrusive role in the development of architectural forms, or to investigate the way in which it creates a translatory medium of this or that consistency. Three instances must suffice to give some idea of what we are dealing with.

The importance of orthographic projection has already been alluded to. Although the geometric principle of parallel projection was understood in late antiquity, Claudius Ptolemy having described it in a work on sundials around AD 300,<sup>15</sup> evidence of its use in architectural drawing is not found until the fourteenth century. The earliest more or less consistent orthographic projection of a building to have survived is a large, detailed elevation of the Campanile of S. Maria del Fiore, preserved in the Opera del Duomo in Siena and thought to be a copy of an original by Giotto, produced after 1334 (Fig. 7).<sup>16</sup> To say that this was the first instance is not deny the existence of many drawings of a similar sort – plans, elevations and sections – going back to the second millennium BC. But the Campanile drawing required two imaginative steps never before taken together, as far as I know. First, a completely abstract conception of projector lines;<sup>17</sup> secondly, an ability to conceive of the thing being represented (the surface of the building) as *not* equivalent to the surface of representation – not quite. The corner bastions of the tower, with their chamfered sides,

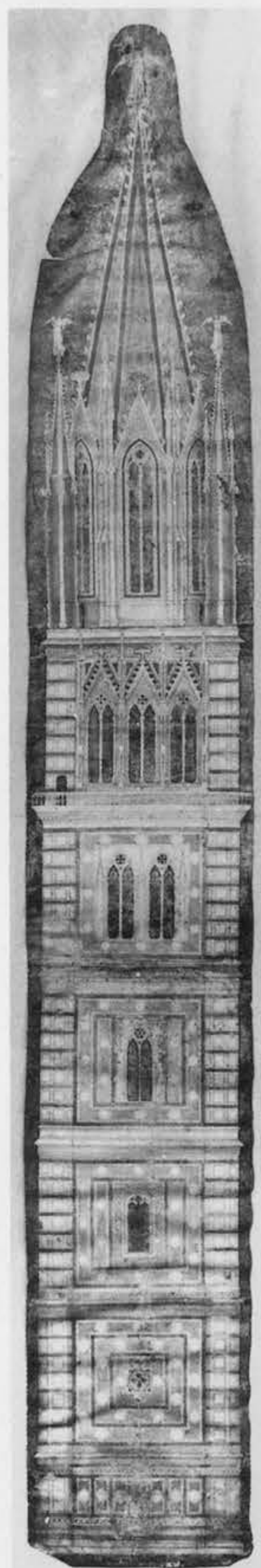


6. Robert Adam, by G. Willison, c. 1770–75.

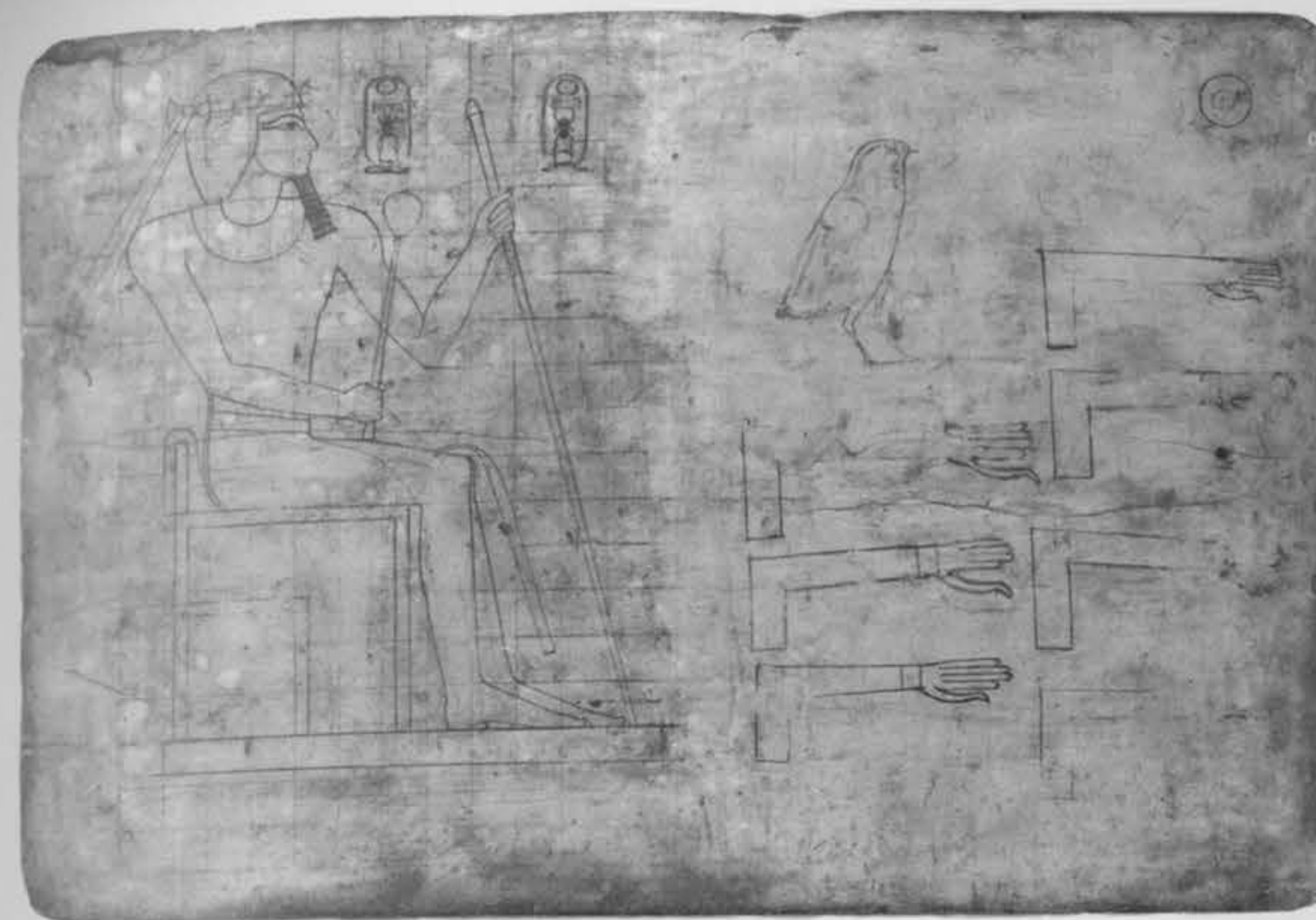
and the diagonal Gothic windows above are drawn obliquely but with no indication of perspectival recession. In other detailed medieval drawings that have survived, orthographic relations are held for all the parts of a facade that are frontal and close to being coplanar, but not in surfaces receding at an angle from the picture plane.<sup>18</sup> In other words, the orthography applied only if the building itself was identified by the draughtsman as sufficiently sheet-like and frontal. To maintain effectively – as did the author of the campanile drawing – the relations between an array of invisible parallel projectors, a plane onto which they are projected at right angles, and other surfaces at various angles to the plane of projection required, at that time, insight of a different order; a good reason, perhaps, for accepting, in the absence of firmer documentary evidence, Gioseffi's contested ascription,<sup>19</sup> since it is acknowledged that as a painter Giotto gave to the presentation of pictorial space far greater coherence than his predecessors.

A comparison of the Campanile drawing with the highly devel-





7. Elevation of project for the Campanile of S. Maria del Fiore, Florence, Giotto copyist, after 1334.



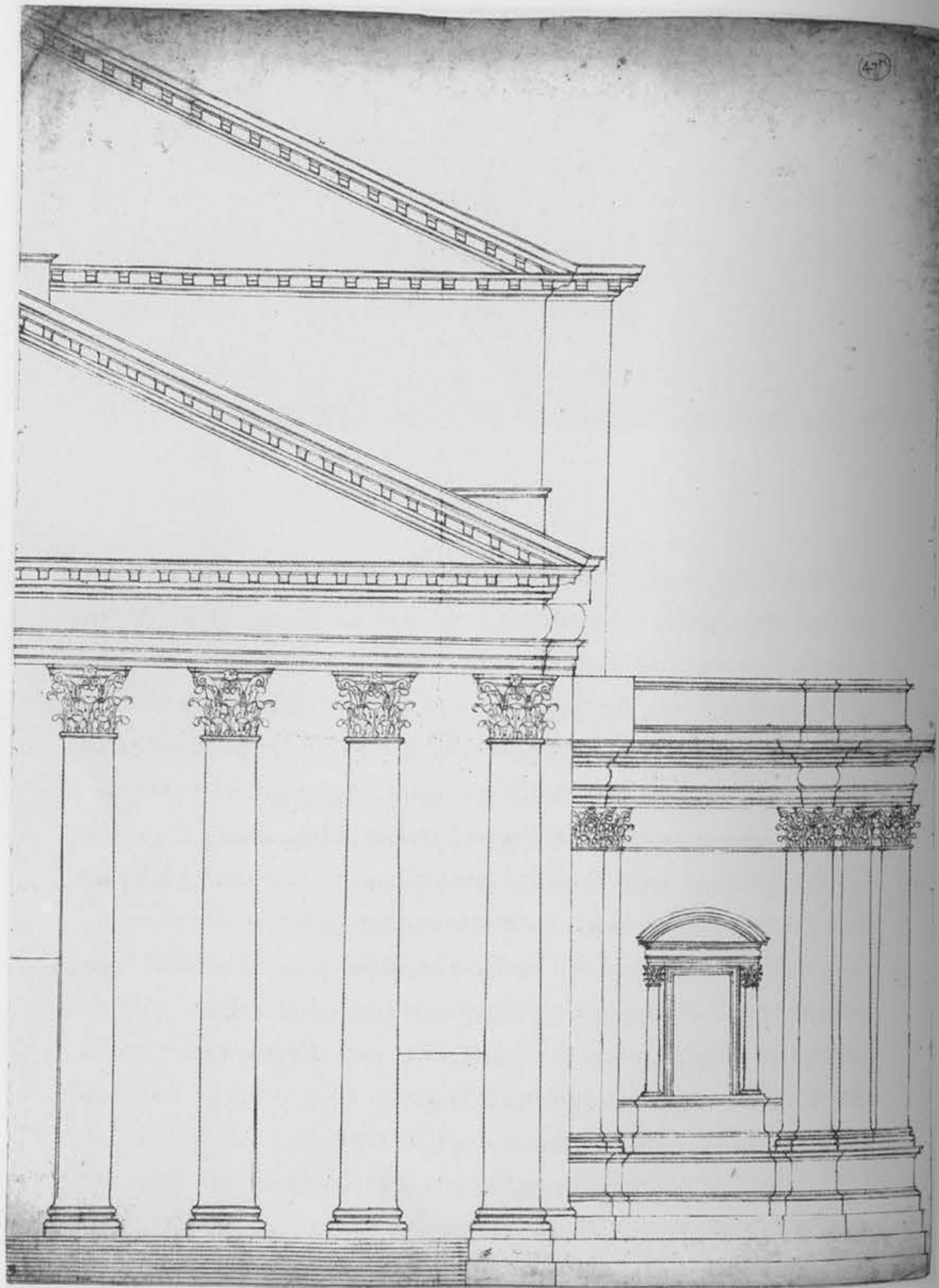
8. Egyptian drawing board. Left-hand area inscribed around 1400 BC.

oped proto-orthography of ancient Egypt, so well preserved on a drawing board of around 1400 BC now in the British Museum (Fig. 8), reveals not only greater reliance on outline in the Egyptian example and the compensatory flattening of the figure across the shoulders, preparing it for re-embodiment in the fossilized compressed form of a bas-relief, but also reliance on a manual activity – the sculptor’s chisel cutting straight into the face of the cubic stone on which the profile was to be inscribed – to make the projectors tangible. Prior to the abstractions of orthographic projection, projectors could be kept in mind through the thoroughly physical realization given them in the fabrication of reliefs and sculptures.<sup>20</sup>

Another choice presents itself: two quite different possibilities attendant on the use of architec-

tural drawing are discernible in the Campanile drawing. It could rest on the simple and primitive expedient of assuming near equivalence between the surface of the drawing and the mural surface it represents. Through the miracle of the flat plane, lines transfer with alacrity from paper to stone and the wall becomes a petrified drawing, inscribed or embossed to lesser or greater degree. Much of this ancient identity remains with us to this day, carried, through classicism, into the professional pastime we call implying depth. To imply depth within a solid three-dimensional body is to conceive of it as being made up of flat surfaces modulated within a thin layer yet giving the impression of being much deeper. It is to attempt to make virtual space and real space at one and the same time and in the same place – a sophisticated idea utilizing simple technical means. In Palladio’s sketch of the S. Petronio facade (Fig. 9) the close alignment (but not quite identity) between drawing and building is at once obvious. This is the kind of architecture that so much fascinated Alberti: a massive, monumental architecture





9. Facade drawing for  
S. Petronio, Bologna,  
by Andrea Palladio,  
1572-9.

engendered from the etiolated, reduced, bodiless elements of 'lines and angles which comprise and form the face of the building';<sup>21</sup> an architecture made through drawing and made of the same species of illusion as is to be found in drawing. For into its patterns of lines stopping and starting we project, by a well-understood reflex of overdetermination,<sup>22</sup> a deeper space. And in just the same way we project into the solid buildings of Alberti, Bramante, Raphael, Giulio Romano and Palladio, borne along by the same absorbing reflex of overdetermination, the illusions of drawing.

I feel as uncomfortable discussing implied depth, which has become one of architecture's most hallowed shibboleths, as I do when wearing someone else's suit. It is nevertheless necessary to do so, if only to point out how the pursuit of this particular illusion has retarded architectural vision by keeping it restricted within the confines of particular conventions. Yet to assert that these conventions were historically uninteresting or fruitless would be to adopt an easy and false posture of disdain. In fact they were



responsible for establishing the drawing as a viable medium, allowing the architect to spill his imagination onto it, sure in the knowledge that much of the effect would travel.

Only with this reassurance of sufficient affinity between paper and wall could the drawing have become the locus of the architect's activity, capable of absorbing all his attentions and then transporting his ideas into buildings without undue disfigurement. Still, if its advantage was the ease of translation, its disadvantage stemmed from the same source: too close a likeness, too cautious a liaison, too much bound up in the elaboration of frontalities.

It may seem obvious that only when fighting this tendency, seeing outside the drawing technique, his imagination soaring above the confines of the medium, can an architect create fully embodied three-dimensional forms. Obvious it most certainly seems, because everyone believes it to be true. It is also demonstrably false. I come now to the second possibility attendant on the use of parallel projection. The assurance and relative precision with which the splayed surfaces were projectively determined in the Campanile drawing indicates that the draughtsman did not need to imprison forms within orthography. Although the correspondence of frontal surface and sheet was still dominant, there is at least a hint that through the rigour of the technique, not despite it, the represented surfaces might prise themselves from the surface of representation, floating free from their captivity in paper – no, attempts at vivid phrasing can do so much damage. Rigorous projection does not free anything, not in the sense of emancipation. Things are just made more manipulable within the scope of the drawing. For any material object to obtain freedom is for its handler to lose control of it, and that does not happen.

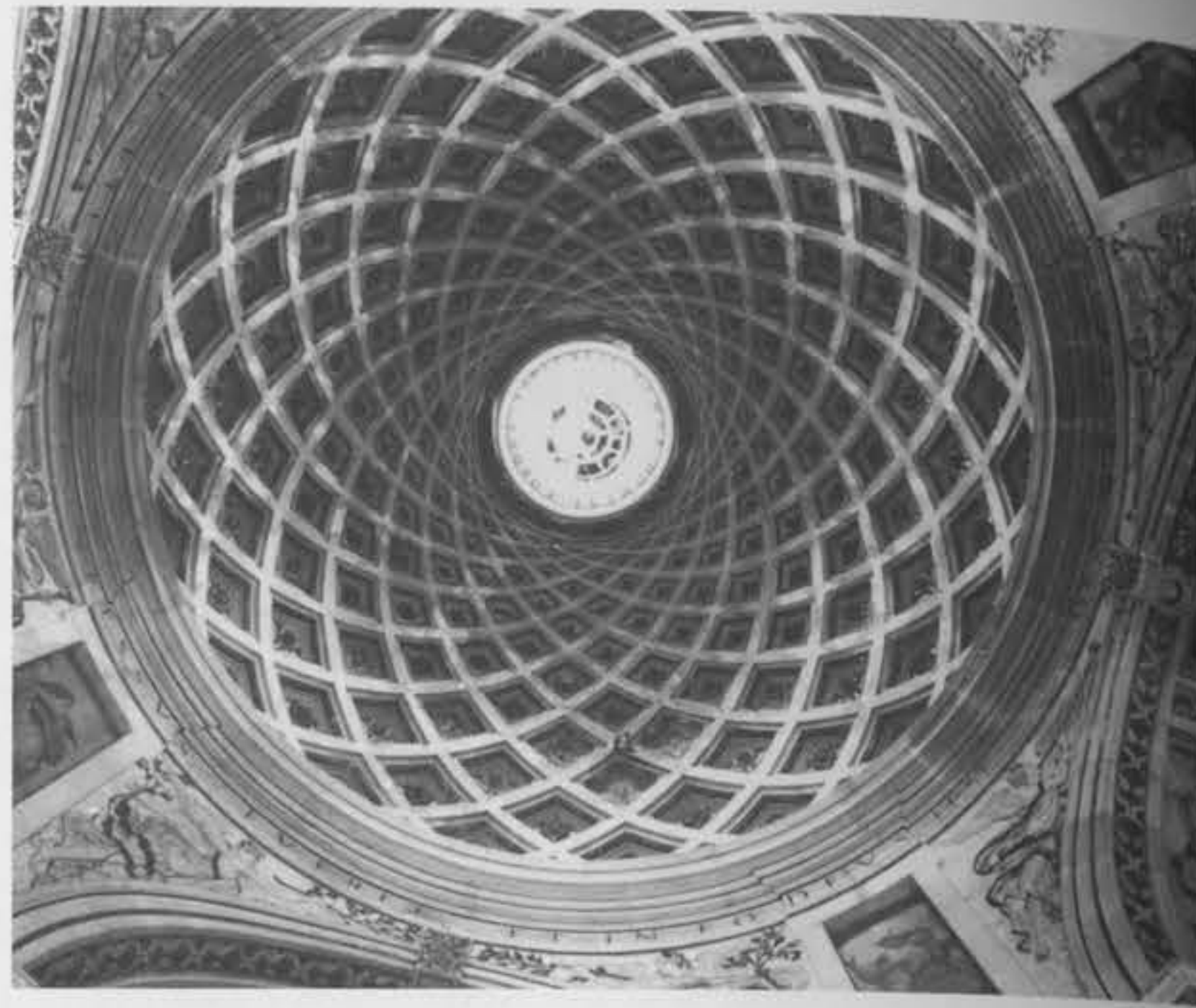
Think of a sheet of paper sprouting thousands of imaginary orthogonals from its surface. In conventional architectural drawing, conservative and fearful of losing conformity, they would not need to be very long before meeting up with the edges of the

imaginary scaled-down surface behind the paper to which the lines of the drawing correspond, and, as in the Egyptian sculptor's elevational drawing, they are often identified with the direction of incision into the stone or, more recently, with the direction of multiplied layering in service of phenomenal transparency; in either event, they act as guide rails into the blindness of an as yet unrealized dimension – short ones securely attached at both ends. What if they were longer and more abstract? Would it strain the architect's power of visualization? Would it endanger his control? Would it jeopardize translation?

The next example I would like to consider involves one detail of a small building by Philibert de l'Orme. De l'Orme, a truly fascinating subject, did more to wrest orthographic projection from the predominantly painterly usage of earlier practitioners (Piero, Raphael, perhaps Giotto) than anyone, and his work deserves better elucidation than I am able to give it in this article. For the sake of the argument, however, this one incident will have to do.

In the dome of the Royal Chapel at Anet, a château west of Paris enlarged for Diane de Poitiers by de l'Orme after 1547, can be seen a net of lines, not exactly ribs and not exactly coffers, neither spiral nor radial (Fig. 10). They are nevertheless laid out and carved with unusual precision. Moreover, their properties, hard at first to describe in stylistic, geometric or structural terms, are directly accessible to vision. Most noticeable of all is the continuous expansion of lozenges, rib thicknesses and angles of intersection as they extend down from the oculus towards the base of the dome. The effect is of a coherent diffusion and enlargement or, conversely, of concentration, remoteness and rotary acceleration towards the lantern. There has never been anything quite like it and, although there are similarly patterned apse heads (as in the portico of Peruzzi's Palazzo Massimo, Rome), Roman coffers (as in





10. Royal Chapel, Anet,  
by Philibert de l'Orme,  
1547–52. View into dome.

the Temple of Venus in Rome outside the Domus Aurea) and pavements (as in Michelangelo's Campidoglio pavement, possibly designed in 1538, though not laid till much later), which de l'Orme could have known about, there is one crucial difference. While all these others were determined metrically, de l'Orme's was determined projectively. We know this because he tells us so:

Ceux qui voudront prendre la peine, cognoistront ce que ie dy par la voute spherique, laquelle i'ay faict faire en la Chapelle du chateau d'Annet. avecques plusieurs sortes de branches rempantes au contraire l'un de l'autre, & faisant par mesme moyen leurs compartiments qui sont à plomb & perpendicule, dessus le plan & pavé de ladicte Chappelle.<sup>25</sup>

This statement suggests that the pattern in the paving is similar to that in the dome, and since this is exactly what we find on the floor of Anet and since de l'Orme has specified perpendicular lines that project into each other, we might let the case rest, as indeed his commentators have.<sup>24</sup>

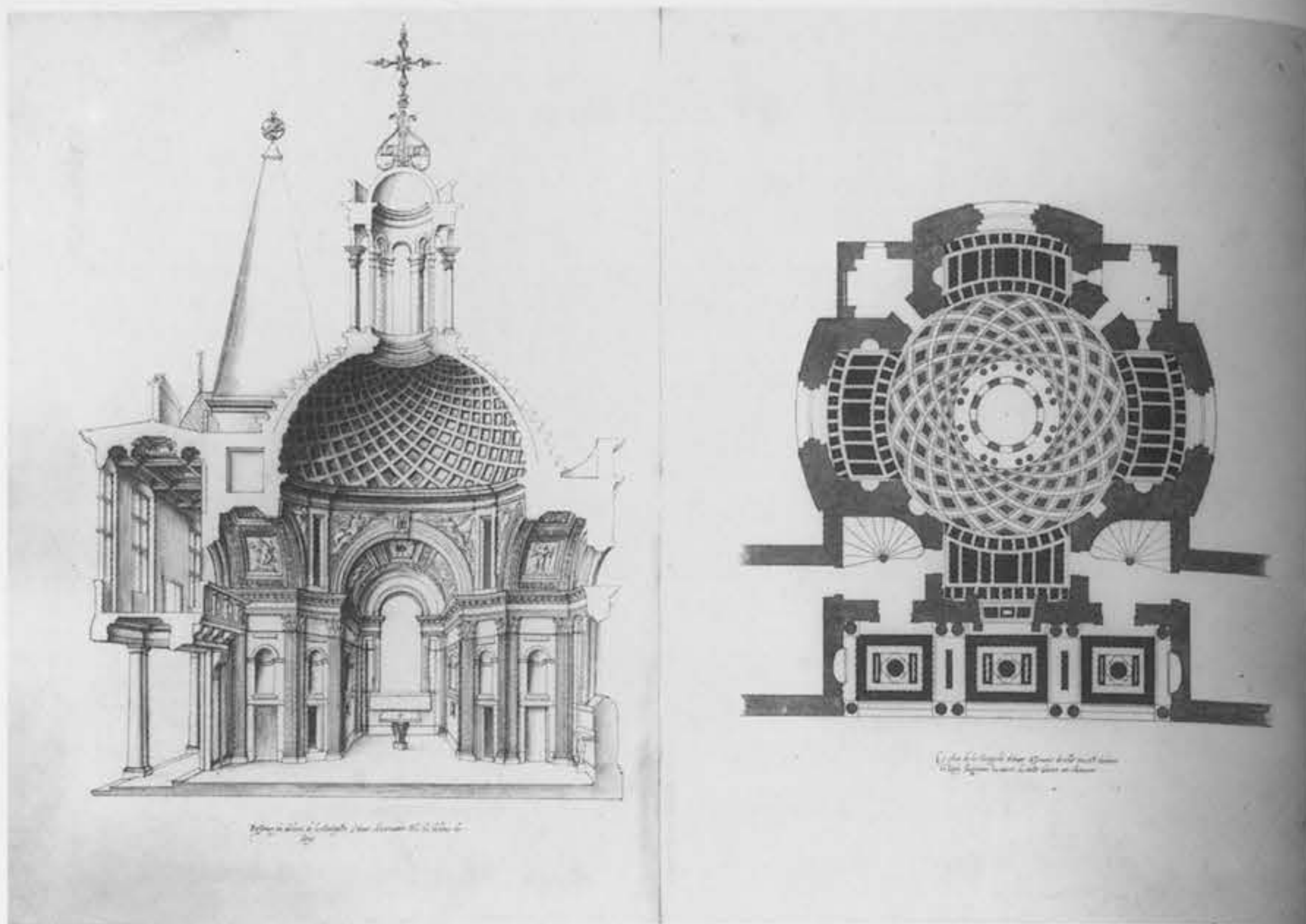
Words are such powerful things, and when they correspond to visual impressions – the floor looks like the dome – they may reasonably stand as proof. Strange to say, this was all an elaborate hoax by de l'Orme, or at least I cannot think of any other explanation for why he should have gone to such lengths to cover his tracks.<sup>25</sup> More interesting than whether it was a hoax or not is why no one noticed the difference. And far more interesting than either is the method he did use to derive the criss-crossing curves under the dome.

One reason it was not recognized is that all the drawings made of the chapel from the sixteenth to the late nineteenth century are manifestly incorrect, unable always to transfer the tracery of the dome, or even the pattern of the floor, without gross bungling (Fig. 11), though the rest of each of the drawings is quite competent.<sup>26</sup> Yet a look at the patterns in the dome and on the floor of the actual building would be enough to convince anyone of the impossibility of de l'Orme's claim. Simply count the number of intersections along one of the eighteen longitudinal lines of the dome, and then count the number of intersections along a corresponding radius on the floor. In the dome there are eight, on the floor six. This alone is conclusive proof that no parallel projection could map the one into the other. De l'Orme's deception was of a peculiar and uncharacteristic sort, because he was doing far more than he owned to, not less.

Another aspect of the difficulty of seeing through the claim is the fugitive character of our third term, the drawing, and its virtual absence from our account of the making of architecture. Invoking it, I shall now try to reconstruct the procedure adopted by de l'Orme for making the tracery of curves.<sup>27</sup>

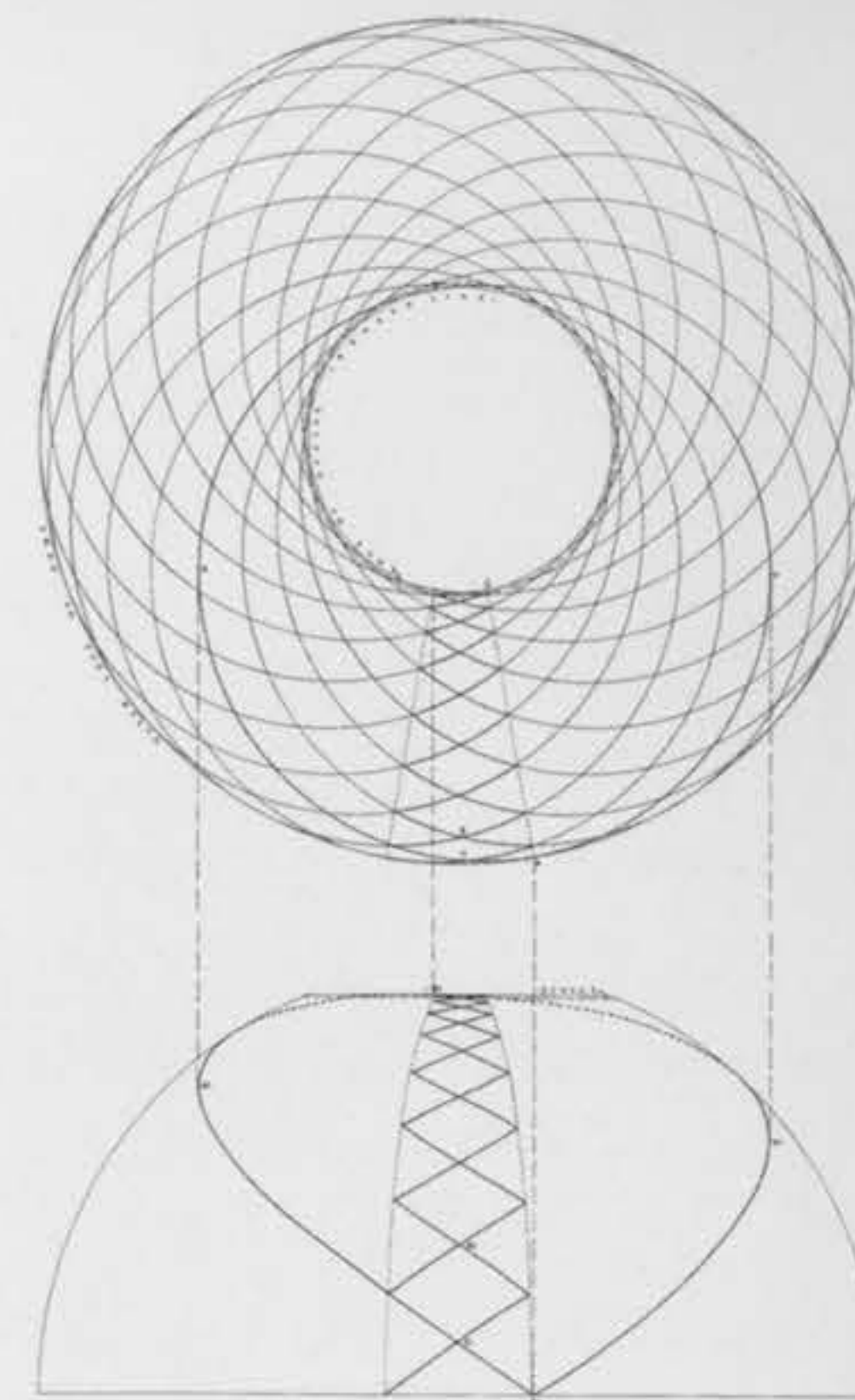
Put out of mind, for the moment, the floor, and look only at the dome. First, notice how the curved ribs approach the oculus ring, glance across it, and return, making eighteen continuous loops around it (in fact the stone wreath around the oculus overlaps the





lines of tangency – see postscript at the end of this article). Then notice how the returning ends of the same loops, as they descend, meet at points along the equator of the dome (obscured by the cornice in the photograph). We may then think of the network as made up of eighteen identical teardrop-shaped rings eccentrically placed on the surface of the hemispheres as if spun round its vertical axis. These are obviously complex, three-dimensional curves, neither circular nor elliptical. The most useful clue so far is in the fact that they make closed loops. How could these complex curves be defined on the spherical surface with such precision? It was certainly not through the expedient of dividing the hemisphere itself into rings of latitude and lines of longitude and then interpolating diagonal curves – the procedure adopted, as far as I can tell, by every other architect faced with a similar problem<sup>28</sup> – as no handy gradation of latitudes could have procured tangency around the oculus. On the other hand, de l'Orme possessed an unusual and, within architecture, perhaps uniquely vivid compre-

12. Suggested plan for the tracery of the dome of the Royal Chapel, Anet, drawn by the author.



11. Plan and perspective section of the Royal Chapel, Anet. Engraving by J.-A. du Cerceau.

hension of projective relations, as can be seen from the *Premier Tome de l'Architecture* that he published in 1567,<sup>29</sup> packed with abstruse stereotomic diagrams involving projections of nameless exotic curvatures. One of the remarkable features of these is that every last one has its origin in a circle. But, as the circles are collapsed, elongated, ramped then projected onto cones, cylinders or spheres at glancing angles, they metamorphose into thoroughly plastic, volatile shapes, commensurable only through the procedure of projection itself. This is the other significant clue.

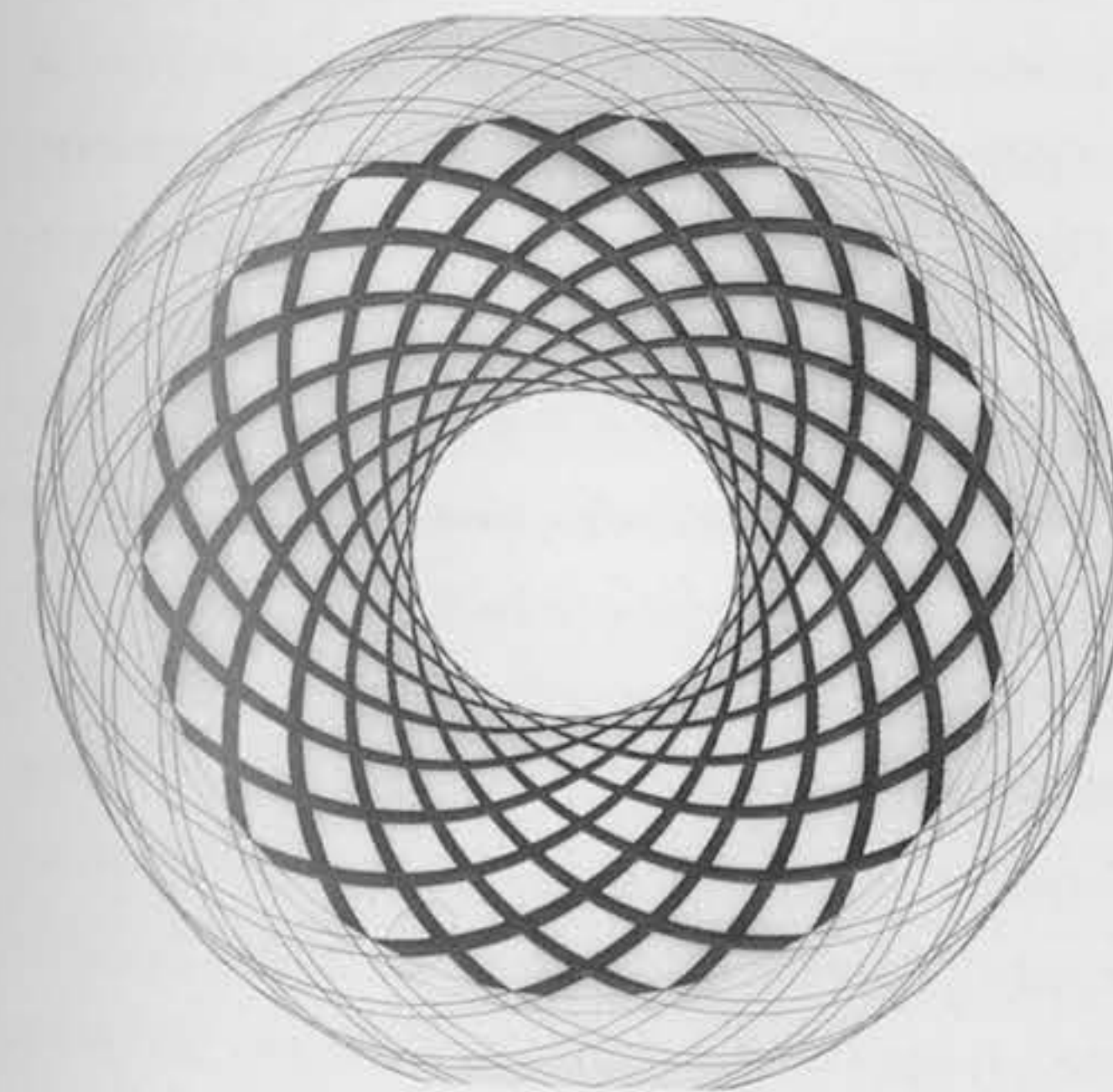
Is there, then, a format of circles on a plane surface that would, through parallel projection onto a hemisphere, transform into a nest of teardrops with the requisite number of intersections? The answer is yes, and it turns out to be the simplest possible arrangement: an annular envelope of circles (Fig. 12). This annular envelope, I suggest, is the real plan of the dome. Each one of the circles within the envelope would produce, under projection, another closed curve, but of quite different shape. The easiest way



to envisage this is to think of the circle as the base of a cylinder (the sides of the cylinder being the projector lines) which cuts through the hemisphere whilst touching its rim.

The resulting closed curve on the hemisphere, half of what is called a hippopede,<sup>30</sup> looks nothing like the circle from which it has arisen and, although the number of intersections stays the same, neither do the original ensemble of circles resemble their projected translation on the dome. The envelope of circles on the plane can be seen to have an unfortunate appearance, the middle lozenges of the annular ring limply slumped in a distribution that has neither the dynamic suggestiveness nor the quasi-structural appearance of the dome, and it fails conspicuously to register the accelerating contraction towards the inner ring so pronounced above. So, rather than dutifully deposit a piece of didactic evidence on the floor, de l'Orme tinkered with it, expanded it and then clipped off its outer rim until it *looked* sufficiently like the system of intersections to which it had given shape (Fig. 13).<sup>31</sup> From this we may infer that, for de l'Orme, in the end, the desire for perceptible likeness took precedence over the desire to demonstrate the rigorous method through which the visible difference had been achieved. The choice to eclipse his own cleverness by marring the projective equivalence between the two patterns is all the more poignant, given his insufferable tendency to brag elsewhere in the *Tome*.

This is an interesting discovery, because it shows the geometric original to be completely expendable, and indeed quite ugly in comparison with its much more wonderful product. Parallel projection in this example engendered more potent forms from less, and did it by an ingenious, regulated distortion of a shape regarded, by common consent, and by de l'Orme himself in his *writings* on architecture, as perfect to start with: the circle.<sup>32</sup> Happy results do not of course occur under guarantee of the drawing technique, also requiring, as they do, an inquisitive mind, a very strong presentiment of the sense within forms, together with a



13A and B. Paving of the Royal Chapel, Anet, shown (left) as a portion of an expanded version of figure 12. Drawing by the author.



penetrating ability to visualize spatial relations. This ability was doubtless enhanced by the practice of projective geometry, but not purchased with it. Still, it would be as crude to insist on the architect's unfettered imagination as the true source of forms, as it would to portray the drawing technique alone as the fount of formal invention. The point is that the imagination and the technique worked well together, the one enlarging the other, and that the forms in question – and there are many more, not only in de l'Orme's work, but in French architecture through to the end of the eighteenth century – could not have arisen other than through projection. A study of de l'Orme's use of parallel projection shows drawing expanding beyond the reach of unaided imagination.

This, then, was architectural drawing in a new mode, more abstract in appearance, more penetrating in effect, capable of a more unsettling, less predictable interaction with the conventional inventory of forms of which monumental buildings are normally composed, destructive also of metric proportionality, the foundation of classical architecture (see below), and suggestive of a perverse epistemology in which ideas are not put in things by art, but released from them. Accordingly, to fabricate would be to make thought possible, not to delimit it by making things represent their own origin (as tiresome a restriction in art as in social life).

The pattern of the dome ribs at Anet does have a provenance. A somewhat dubious iconography may even be sketched out. Ackerman, in his study of Michelangelo's Campidoglio pavement, found a medieval astronomical chart in a similar pattern of twelve rings, indicating lunar revolutions during the course of a year. It is possible, though by no means certain, that an investigation of sources would reveal links between the solar and lunar charts, other diagrams of this form, the Campidoglio pavement and Anet.<sup>33</sup> It might even divulge an informing symbolism that would explain the increased number of rings at Anet. Although this has not yet been done, let us assume that the quest for symbolic meaning would

yield persuasive results. Where would this symbolism reside, if not in the envelope of circles, which was really no more than an expendable piece of formwork for the transfigured phenomenon of the dome? Would we not be forced to concede, in the circumstances, that the symbolism was a mere ingredient, lost in form, not carried in it?

What comes out is not always the same as what goes in. Architecture has nevertheless been thought of as an attempt at maximum preservation in which both meaning and likeness are transported from idea through drawing to building with minimum loss. This is the doctrine of essentialism. Such essentialism was held to be paradigmatic throughout the classical period. It was held to in architectural *texts*, but not always in architecture. The notable thing about the working technique used by de l'Orme, which could only be written about from within the limits of architectural theory as a way of moving truth from here to there, was in the enchanting transfigurations it performed. Curiously, the pliability of forms was made possible by a homogenization of space. Orthographic projection is the language translator's dream. Within its axioms the most complex figures may be moved at will into perfectly congruent formations anywhere else, yet this rigidly defined homogeneity made distortion measurable. It was this capability that de l'Orme exploited.

Orthographic projection played its part as one of numerous techniques used by artists and architects to counteract the rampant instrumentality of essentialism,<sup>34</sup> which would have art be a form of haulage, transporting incorporeal ideas into corporeal expressions. And there is an amusing irony in the prospect of the rigid bunch of spectral parallels along which lines were pushed in orthographic projection, disturbing the rigidly graded conceptual space through which ideas were pushed into things.

The theme of this article is translation, and I am now talking about transportation. There are all those other identically prefixed



nouns too: transfiguration, transformation, transition, transmigration, transfer, transmission, transmogrification, transmutation, transposition, transubstantiation, transcendence, any of which would sit happily over the blind spot between the drawing and its object, because we can never be quite certain, before the event, how things will travel and what will happen to them on the way. We may, though, like de l'Orme, try to take advantage of the situation by extending their journey, maintaining sufficient control in transit so that more remote destinations may be reached. I retain this inane parable, as it gives some idea of what I believe to be the largely unrecognized possibility within drawing. One infidelity does stand out, however: these destinations are not like exotic, far-away places waiting to be discovered; they are merely potentialities that might be brought into existence through a given medium.

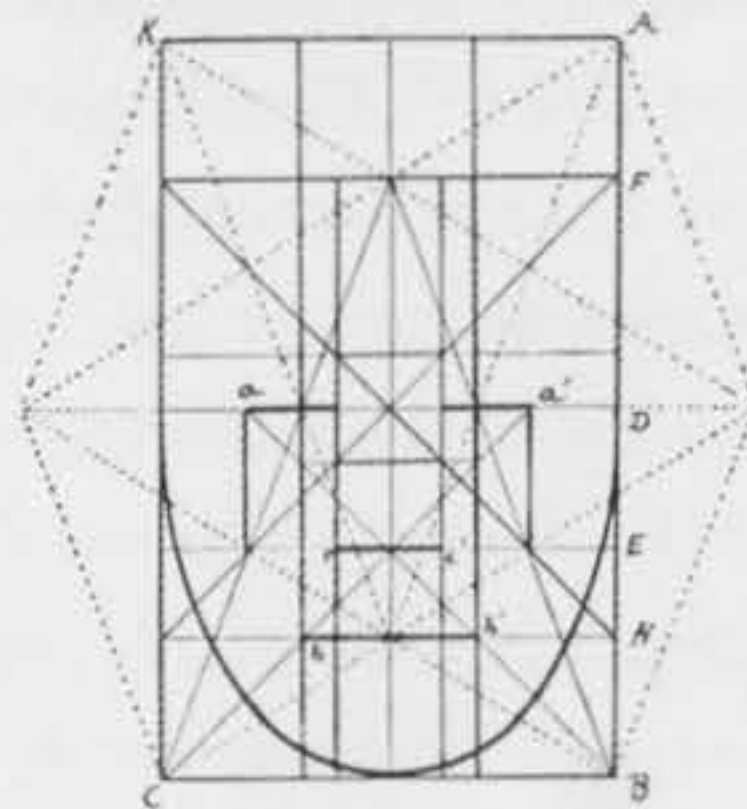
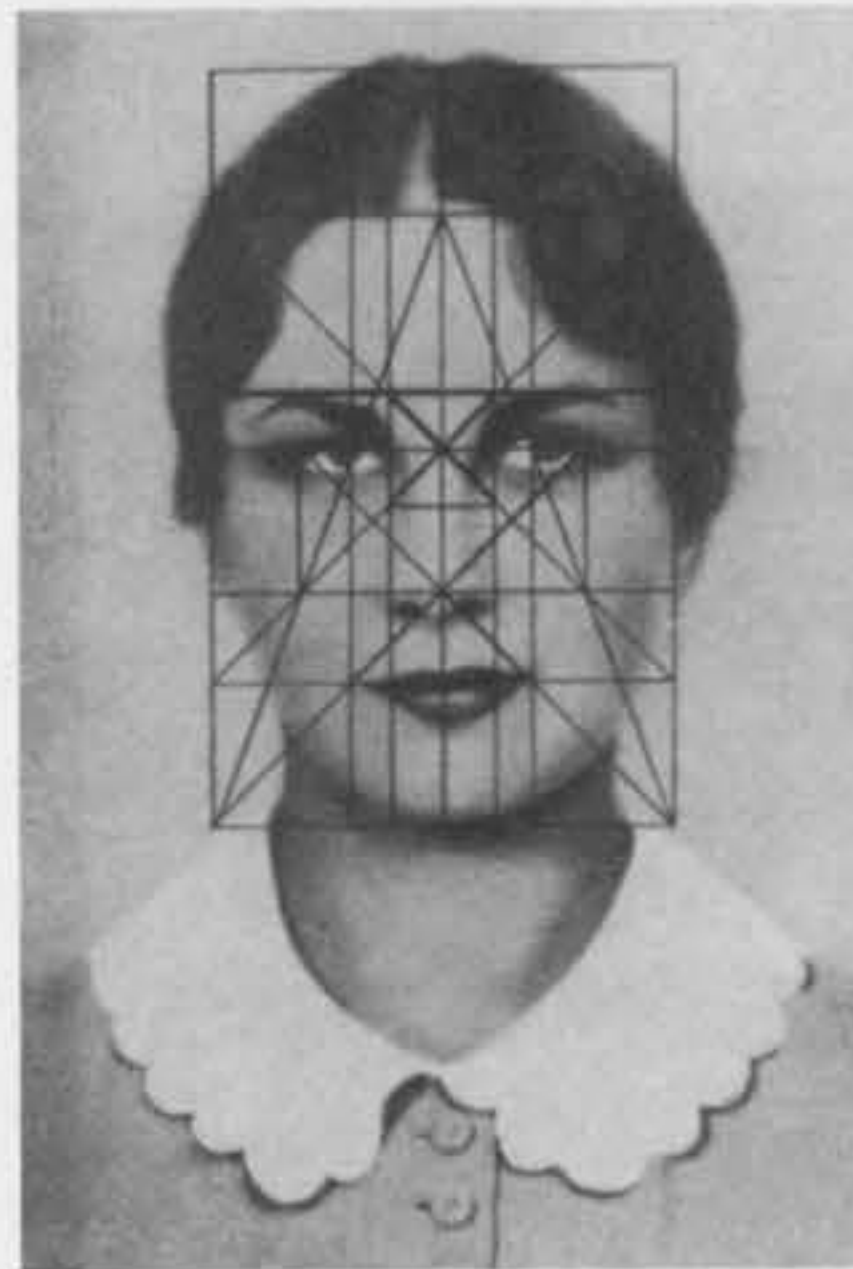
But always standing in the way are the pieties of essentialism and persistence (the confusion of longevity with profundity). Whatever modernism's much ventilated destructive achievements, it made no mark on these. In the region of drawing they operate either through insistence on a true and irreducible expressiveness, or insistence on perspectival realism, or in the demand that only pure geometric forms or ratios be employed.

As regards the last, numerous analyses have been published, from the seventeenth century to the present day, divulging the secrets of the world's greatest works of architecture in the presence of underlying proportions. Without denying either the presence of or the need for proportionality in architecture, attention might be directed to certain misconceptions. Not all proportionality is reducible to ratio, yet it is only as ratio that it has been admitted into architectural theory. A ratio is a comparison between two numbers, as  $1:\sqrt{2}$  or  $3/4$ . Since numbers, having no tangible reality themselves, must be wilfully pushed into things, we have to ask how ratio can be made sensible in architecture; the answer leads back to our point of departure, the drawing.

While the simplest means of expressing a ratio outside of number is as the division of a line, the second most simple expression is as an area, length to breadth. In this surface-making form, ratio resides in architecture. Ratios thus expressed fill a sheet like Lord North filled a chair: squarely. And it has to be a sheet of paper with no rucks or folds, and it has to be viewed frontally, otherwise the proportionality degenerates. The less Euclidean the plane, or the more oblique the point of view, the more degenerate the form. Nevertheless, as long as the surface of the building maintains sufficient identity with the sheet of paper, proportional ratios may be transferred with little loss. The very architects who used this approximate identity to such advantage, from Alberti to Palladio and later, were preoccupied with establishing a canon of proportions. They were also keenly aware of the dangers that lurked in the third dimension, ready to degrade the beauty constructed so painstakingly in the flat.<sup>35</sup> But, although this was a perplexing difficulty, it was in accord with the entropic account of value given in the doctrine of essentialism. Things were supposed to degrade as they moved from idea to object. It was a difficulty easy to articulate in theory, whereas the transfiguring capability in the drawing was a potential advantage that was not.

To judge from the nostalgic and at the same time dogmatic character of much twentieth-century literature on architectural proportion, all that has been well and truly 'lost' is any sense of the intrinsic limitation of the idea, one remarkable demonstration of this regained innocence being the analysis supplied by Matila Ghyka of Helen Wills's face to prove that her beauty was founded in the golden ratio.<sup>36</sup> The analysis is not of the rotund, undulating, folded, punctured surface we call a face, but of quite another surface, onto which the face was flattened by the process of photography (Fig. 14). I present this as an inverted parody of de l'Orme's procedure at Anet. The existing, alluring, complex curvature of Wills's face is projected through a camera lens onto a flat surface





$$\frac{AB}{BC} = \frac{AD}{FD} = \frac{DB}{EB} = \phi = \frac{\sqrt{5}+1}{2}$$

$$\frac{FD}{DE} = \frac{EB}{HB} = \phi$$

$$\frac{CB}{a'a'} = \frac{b'b'}{c'c'} = \phi$$

14. Three stages of the proportional analysis of Helen Wills's face, from *Le Nombre d'or*, by Matila Ghyka, 1931.

upon which is then inscribed an unprepossessing visor of lines constructed from basic elements of plane geometry. Start from the end and work backwards, and you get the spun fretwork in the Anet chapel dome. In Ghyka's analysis, basic plane geometry ended up as a foundation; at Anet it was just the beginning.

De l'Orme's was not the only way; there were others, equally efficacious. A study of other projects that ruptured the equivalence between drawing and building – Borromini's S. Carlo alle Quattro Fontane or Le Corbusier's Ronchamp – would show architects working quite differently though perhaps, in both instances, more in accord with our prejudice that architects of genius (the horse tormented by its bridle, the caged lion, to use Borromini's bestial images of himself)<sup>37</sup> must wrest themselves free from the restriction of geometrical drawing rather than use it. While I have no argument with this point of view *per se*, it has left us insensitive to the potency that has existed – still exists – in the precision of the drawing, which is also capable of disengaging architecture from those same stolid conformities of shape, propriety and essence, but from within the medium normally used to enforce them.

Two current advertisements: a TV commercial for household paint which shows the frenetic and messy antics of a barbarous Glaswegian artist whose studio is all the while being painted spotless white by a meticulous, imperturbable decorator; a newspaper ad for the Youth Opportunities Programme that shows a lout spraying 'Spurs' onto a wall, later transfigured into a white-coated apprentice painting a trim little nameplate for the same football club. Here is the absurd public prejudice in favour of neatness: neatness as a sign of civilization. There is a counter-prejudice, a reaction, a cultured expiation no less limiting, really, which operates in favour of the unpremeditated and unregulated as signs of art and feeling. Neither will do. Yet there is something about the way people work.

It would be possible, I think, to write a history of Western architecture that would have little to do with either style or signification,





15. *The Ancient of Days*,  
by William Blake.  
Frontispiece to *Europe:  
A Prophecy*, 1794.

concentrating instead on the manner of working. A large part of this history would be concerned with the gap between drawing and building. In it the drawing would be considered not so much a work of art or a truck for pushing ideas from place to place, but as the locale of subterfuges and evasions that one way or another get round the enormous weight of convention that has always been architecture's greatest security and at the same time its greatest liability. This is one of my ambitions: the history of Blake's architect geometer has been written a hundred times (Fig. 15); I would like to write the history of Giacinto Brandi's (Fig. 16),<sup>38</sup> not, I hasten to add, because she is so young and pretty, but because of the uncharacteristic expression on her face and in her posture. It is the kind of expression normally reserved in seventeenth-century painting for prostitutes and courtesans. The picture's subject is uncertain, its title a modern supposition resting on the fact that she holds dividers, nothing more. One might ask what such a figure is expected to do with the instrument she shows us.

16. *L'Architettura* (?),  
by Giacinto Brandi,  
seventeenth century.





## POSTSCRIPT

I wrote this article before visiting Anet and seeing the dome and floor of the chapel. It seems to be as I described it, with the exception of one detail which had escaped my notice in the photographs available to me. After my return, another photograph – one that I had taken – showed this up. It is easier to discern projective relations between two such surfaces in photographs than in the building itself, where they cannot both be held in view at the same time, and it is only the recollection of apparent similarity that carries the idea of their relation within the building. (Given the difficulty of direct comparison, de l'Orme's modification of projective equivalence to make the two surfaces look more alike is all the more effective and all the more artful.) The anomaly in my account of the chapel dome concerns the relation of the eighteen ribs looping round the lantern ring. I had thought that they pass across the edge of the lantern ring tangentially – and seen from the floor they give every appearance of doing so – but they do not. In fact the lantern ring cuts a little way into the edge of the pattern of intersections, eliminating the final circle of half lozenges. Evidently this was another of de l'Orme's modifications of projective equivalence, because the marble inlay on the floor does include this part of the pattern. It is possible that this particular modification had less to do with the forging of apparent likeness between dome and floor than with the technical difficulty of cutting such acute angles in the more friable stone of the dome.

## NOTES

1. From the Latin *translatio*, to remove or carry from one place to another.
2. Lawrence Weschler, *Seeing is Forgetting the Name of the Thing One Sees* (Berkeley, 1982). A study of Robert Irwin.
3. Michael Baxandall, *Giotto and the Orators: Humanist Observers of Painting in Italy and the Discovery of Pictorial Composition 1350–1450* (Oxford, 1971).
4. T.J. Clark, *The Image of the People* (London, 1973); *The Absolute Bourgeois* (London, 1972); *The Painting of Modern Life* (London, 1984).
5. Norman Bryson, *Word & Image: French Painting of the Ancien Régime* (Cambridge, 1981); *Vision & Painting: The Logic of the Gaze* (London, 1983).
6. Bennington College, Vermont.
7. The most stimulating account of this slipping-over of the categorical boundaries is Rosalind Krauss's 'Sculpture in the Expanded Field', *October* 8 (1979); also in: Krauss, *The Originality of the Avant-Garde and Other Modernist Myths* (Boston, 1985).
8. Others might include Walter de Maria, Robert Irwin, Gordon Matta-Clark, Donald Judd, Robert Smithson, Michael Heizer, Christo, Robert Morris, Dan Flavin, DeWain Valentine, Mario Merz, John Atken, Sarah Bradpiece, David Mach, and so on. The question with these artists is not whether they use drawings (some do), but how they use them and why. Above all, the question is to what extent the drawing, if used as a means of investigation, imparts significant properties to the thing it represents. Many of the works of the artists listed, which are geometric and apparently reducible to drawing, are not, since they possess properties of substance and luminosity which, though they may be mimicked in drawing, cannot be developed in investigative drawing. To imagine that they can is a fruitless illusion now being fostered in architectural schools.
9. This is true, for instance, of Kay Larson's otherwise excellent review of Turrell's Whitney retrospective in *Art Forum*, January 1981, pp. 30-33.
10. I am conscious of how similar my description is to Barbara Haskell's description of *Laar*, another of Turrell's installations, which appeared in *Art in America*, May 1981, pp. 90-99. I knew of Haskell's article before I saw Turrell's work for myself and even read it out in lectures. I then made an effort to write about this type of installation differently, but found I could not do so to any effect. This is certainly an indication of my indebtedness to Barbara Haskell. It may also indicate an inescapable consistency in Turrell's work. See also Kay Larson, *op. cit.*, and Suzaan Boettger, *Art Forum*, September 1984, pp. 118-19.
11. Pliny the Elder, *Natural History*, vol. xxxv, para. 151. See also K. Jex-Blake, *The Elder Pliny's Chapters on the History of Art* (London, 1896). The story adapted by the painters was recorded by Pliny as of the origin of *modelling* (Diboutades' father, a potter, afterwards filling in the outline of the head with clay to make a relief).



12. Schinkel's painting is uncharacteristic within the genre. Although it is accepted as illustrating the Diboutades story, in which Pliny describes the shadow falling on a wall, the complete absence of architecture is, as far I know, unique, except for an early variant by Joachim von Sandrart, 1675. Schinkel seems to have conflated the Pliny anecdote (a woman as the inventor) with Sandrart's shepherd tracing the shadow of his sheep on the ground. See *K.F. Schinkel: Architektur, Malerei, Kunstgewerbe* (Berlin, 1981), catalogue entry 207a, p. 267; and Robert Rosenblum, 'The Origin of Painting', *Art Bulletin*, Dec. 1957, pp. 279-90.
13. This paradox was pointed out by Lethaby, one of Webb's greatest admirers. See W.R. Lethaby, *Philip Webb and his Work* (London, 1979), pp. 117-25. 'There are two ideals', he writes, 'sound, honest, human building, or brilliant drawings of exhibition designs.'
14. A distinction has to be made between those portraits of artists in which the tool represented the occupation (paintbrush, chisel or dividers) and those in which the work itself was shown.
15. G.T. Toolmer, 'Claudius Ptolemy', in *Dictionary of Scientific Biography*, edited by Gillespie, vol. xi, pp. 186 ff.; and Claudii Ptolemaei, *Liber de Analemmate* (Rome, 1562), which includes many diagrams.
16. Decio Gioseffi, *Giotto Architetto* (Milan, 1963), pp. 82-4. Close inspection reveals some minor inconsistencies in projection. For example, the facets of the corner bastions that are decorated with squares of dark marble inlay are shown with the vertical strips of inlay registering the same width in frontal and oblique planes. In a few of the lower panels, however, the proportional reduction on the oblique surfaces was shown correctly.
17. It is interesting that the story of the origin of Greek geometry, also included in Pliny, is very similar to that of the origin of drawing. It tells of Thales finding the height of an Egyptian pyramid by measuring the length of its shadow on the ground and comparing it to the shadow made at the same time of day by a smaller vertical of known height. To recognize the formal equivalence between these two things requires, as Meserve points out, imaginary lines to be conceived as joining the tops of the verticals with the ends of their shadows on the ground, thus inaugurating a geometry of abstract lines. The impercipience in the story, claiming that the abstract line was discovered in the measurement of a building, the construction of which would have required that knowledge beforehand, is discussed by Serres. See Bruce Meserve, *Fundamental Concepts in Geometry* (New York, 1983), pp. 222-3; and Michel Serres, 'Mathematics and Philosophy: What Thales Saw...', in *Hermes* (Baltimore, 1982), pp. 84-96.
18. One of the finest examples of this type is also in the Opera del Duomo in Siena, a drawing of the Siena Baptistery facade made around 1370, probably by Domenico Agostino. The deeply recessed portals and aisle windows depart from orthographic projection. See John White, *Art and Architecture in Italy 1250-1400*

- (Harmondsworth, 1966), p. 327 and plate 154. White also discusses the earliest Italian drawing of this type, the Orvieto Cathedral facade by Lorenzo Maitani, about 1310 (p. 292).
19. Edi Baccheschi, *L'Opera Completa di Giotto* (Milan, 1966), p. 126. Baccheschi contests the attribution; however, White (*supra*, p. 172) accepts it as probable while Trachtenberg argues strongly that it is Giotto's scheme and may even be his drawing (M. Trachtenberg, *The Campanile of Florence Cathedral: Giotto's Tower* (New York, 1971), pp. 21-48).
20. According to Panofsky, this was the case with not only Egyptian reliefs but also sculptures in the round. See Erwin Panofsky, 'The History of the Theory of Human Proportions as a Reflection of the History of Styles', in *Meaning in the Visual Arts* (New York, 1955), pp. 60-62.
21. L.B. Alberti, *The Ten Books of Architecture*, translated by Leoni, edited by Rykwert (London, 1955), book i, chapter i.
22. E.H. Gombrich, *Art and Illusion* (London, 1972), part iii, especially 'The Ambiguities of the Third Dimension', pp. 204-44.
23. 'Those who would take the trouble, will understand what I have done with the spherical vault that I had to make for the chapel at Anet, with several sorts of branches inclined in contrary directions and forming by this means compartments that are plumb and perpendicular above the plan and paving of the said chapel.' De l'Orme, *Le Premier Tome de l'Architecture* (Paris, 1567), chapter xi, p. 112.
24. The most comprehensive recent work on de l'Orme is Anthony Blunt's *Philibert de l'Orme* (London, 1958). Blunt noticed and accepted the projective relation in question (p. 43).
25. De l'Orme, having noted the projection of the floor into the dome, referred the reader to a similar proposal, which he proceeded to demonstrate and explain. This did involve projection of a plane surface into a spherical surface (*supra*, chapter xii, pp. 112-13), but it was a much simpler pattern of concentric squares on a pavement whose effects in the dome could quite easily be visualized from the plan alone.
26. The perspective section published by de l'Orme himself, primitive, like most of his perspectives, showed the tracery inaccurately and did not indicate the floor pattern (although there is one variant of this which does include the pavement and shows it with the same number of intersections as the dome). No orthographic drawings of the chapel by de l'Orme survive. The plan published by Androuet du Cerceau in *Les plus excellents bastiments de France*, vol. 2 (Paris, 1607), showed the floor nearly as laid (wrong number of arcs, right type of configuration), but the superimposition of the lantern plan obscured the most critical area of the pattern. The plan from the survey published by Rudophe Pfnor in *Monographie du Château d'Anet* (Brussels, 1867), to all appearances much more accurate, preserved the topological characteristics of the nest of curves, but did



not draw them as circular arcs, while in the section both the curves and their intersections in the dome fail to correspond to the pattern as constructed.

27. Blunt noted the ingenious nature of the coffering pattern, its departure from the usual method of compartmenting domes using lines of latitude and longitude, and the inaccuracy of available drawings, yet despite these perspicacious observations his own account went quickly awry. He wrote: 'through each of the 16 (*sic*) points on the oculus two great circles are drawn, linking it with two points on the equator separated from it on ground plan by what appears to be an angle of  $180^\circ$ '. What Blunt did was to give a description of du Cerceau's plan of the pavement (with its sixteen pairs of branches, not eighteen, calling the arcs great circles and not taking into account the superimposition of the lantern plan in the du Cerceau drawing, which artefact gave rise to the effects he described in this passage. In other words, he was describing part of a drawing of the floor, not the whole of the dome (great circles could not in any case meet twice on a hemispherical surface unless both intersections were on the rim). See Blunt, *supra*, pp. 39-42. For my own investigations I have used a crude photogrammetry, with photographs of the dome and floor from the Conway Library, Courtauld Institute, and in *Country Life*, 16 May 1908, pp. 702-4. The method, in my hands, is not foolproof, but it is probably adequate. Certainly it gives far more reliable results than could be obtained from existing drawings.
28. If a sphere is divided as is a terrestrial globe, with lines of equal longitude and latitude, and the diagonals are joined, a pattern of this type emerges (see Fig. 11 in this article, from W. Jamnitzer, *Perspectiva Corporum Regularium* (Nuremberg, 1568), series G, plate v). It differs significantly from the arrangement at Anet, however, in that all the spiralling diagonals radiate from the poles. At Anet this area is completely empty of curves. A simple metric division also gives the pattern of Michelangelo's Campidoglio pavement. An oval constructed with major and minor arcs of equal length made the division of each of the four component curves into six equal parts along the perimeter an easy matter. Radii were joined to these from the centre of the oval, and then these radii were themselves divided into six equal parts. Joining these together produced a spider's web of concentric ovals across radial lines. Alternating diagonals within the network produced the pattern. Again, all the diagonals converged on the centre.
29. De l'Orme's stereotomy requires a separate study. His was the first publication of the technique which maintained a distinct presence in French architecture well into the eighteenth century and was systematically taught well into the nineteenth. See J.-M. Pérouse de Montclos, *L'Architecture à la Française* (Paris, 1982), parts 2 and 3, especially pp. 80-95.
30. The hippopede was one of the few curves, other than the circle and the conic sections, that was well established in ancient Greek geometry, its properties having been investigated by the mathematician Eudoxus in the fourth century BC. See Carl Boyer, *A History of Mathematics* (New York, 1968), p. 102. It is an

open question whether this was known to de l'Orme and, if it was, how it contributed to his use of it in the chapel dome.

31. This interpretation accords with the decreased number of intersections on the pavement. More importantly, it accords with the morphology of the pavement lozenges. In the envelope of circles I have proposed as the basis of the dome tracery the lozenges are broadest in the middle of the annular ring and flatten towards the inner and outer rims. The pavement as built, by increasing the radius of the circles and extending the outer rim of the envelope, plots only six of the original eight rings of lozenges onto the available floor space. The fact that the fourth and fifth rings of lozenges (numbered from the oculus outwards) are the same proportion, while the sixth (outermost) ring is noticeably flatter and comparable in proportion to the third ring, supports this conjecture, since this is exactly the property of the full eight-ring envelope of curves. Not only does this make the floor pattern look more like the expansive dome pattern, but the projecting cornice below the dome cuts the lower rim of the dome itself from view, obscuring much of the lowest ring of lozenges and making its observable density even more nearly equivalent to that of the floor.
32. De l'Orme, *Premier Tome*, p. 33. Yet de l'Orme was nowhere near as insistent on the perfection of the circle as other sixteenth-century writers on architecture, preferring to concentrate his praise on the figure of the cross.
33. James S. Ackerman, *The Architecture of Michelangelo* (Harmondsworth, 1986), pp. 167-8. I am grateful also to Richard Patterson for information on this.
34. It is now often taken for granted that idealism and essentialism save us from the kind of instrumentality that comes with positivism. This they may or may not do. But I would insist that they bring with them other kinds of instrumentality and other varieties of subjection just as unsavoury. I would insist also that only some kinds of instrumentality are unsavoury.
35. Thus Alberti, who had done more than anyone to propagate knowledge of perspective in his book on painting, accused it of distortion in his book on architecture (*The Ten Books on Architecture* (1955), p. 22). In the ensuing centuries, proportion, its inevitable distortion by the eye, and its practical 'adjustment' to counter the optical deceptions of three-dimensional embodiment were discussed by numerous authors. Claude Perrault gave a brilliant though highly critical account of both proportion and adjustment in *Ordonnance des cinq espèces de Colonnes* (Paris, 1683) (*Treatise on the Five Orders*, translated by John James (London, 1708)).
36. Matila Ghyka, *Le Nombre d'Or* (Paris, 1931), p. 55 and plates 18-20.
37. Joseph Connors, *Borromini and the Roman Oratory* (Boston, 1978), p. 3. Connors's lecture on S. Carlo at the Architectural Association in 1982 was very informative about Borromini's use of drawing.
38. Renato Guttuso, *L'opera completa del Caravaggio* (Milan, 1967), pp. 108-9.