

Aarhus School of Architecture // Design School Kolding // Royal Danish Academy

Borromini's Smudge

Foote, Jonathan

Published in:
Drawing Matter Journal

Publication date:
2022

Document Version:
Publisher's PDF, also known as Version of record

[Link to publication](#)

Citation for pulished version (APA):
Foote, J. (2022). Borromini's Smudge. *Drawing Matter Journal*, (2), 1-28.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

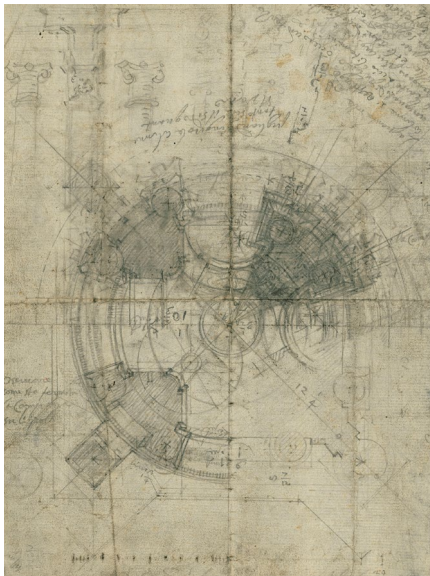
Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Borromini's Smudge — Jonathan Foote

*'Shall I then wallow in the geometrician's dust?'*¹

Introduction



1—

Widely admired for their intensity, layering and depth, the drawings of Francesco Borromini (1599–1667) captivate the viewer not only for their daring designs, but even more for the finely granular, dusty quality emanating from their surfaces. Hatch lines dissolve into fogs of smoke, while ornaments and cornices emerge from beneath mysterious crevices and corners. The levity of graphical textures gives the sense that the marks and smudges are lifted up from the drawing surface, inviting the imagination inside (Fig.1). Scholars have generally understood Borromini's smudgy graphite marks as evidence in the progression from rough to precise geometrical resolutions – of teasing out form from formlessness, thus following in the theory of creative, graphic production in place since the late 15th century. This interpretation, however, tends to overlook the way that Borromini actually engaged architecture, where both the drawing and the building site were utilised in a process of continuous ideation.² For Borromini, the drawings not only represent specific forms or spaces but are also fundamentally imagined as constructions in their own right, based on corresponding, material practices. Thus, when not only the form but also the architect's construction materials and techniques are brought into consideration, the smoky character of his graphite drawings invites new readings.

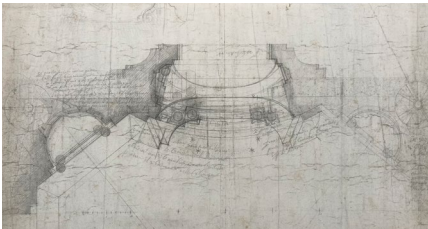
As is well known, Borromini's architecture relied on relatively inexpensive, yet highly malleable building materials.³ Primarily, this involved a wall and vault construction of re-used brick, called *tevo/ozze*, covered with white stucco made with marble dust, called *stucco romano*. This material dialectic, firmly rooted in Roman building culture, provided the support for the architect's signature approach to light and space. The inherent anti-modularity of chipped and broken bricks, along with the 'pasty' stucco covering, offered the possibility to explore the architectural potential of details and surfaces more freely. Borromini's approach to drawing – often characterised by making repeated passes, pressing deeply into the paper, allowing the graphite to smudge and smear – produces a result that easily recalls his plastic approach to the broken brick and stucco material dialectic. It furthermore suggests material sympathies between the graphite dust and other kinds of particulate matter imagined in the building process, such as dusty matter in the air, or the fine, white powders produced for the stucco. Placed together – smeared graphite and supple wall materials – Borromini's approach to shaping and profiling offers

surprising readings and stands in stark contrast to the idealised geometrical schema in which he is normally framed.

This essay argues that, for Borromini, graphite was a critical tool for evaluating not only the visual aspects of a building but also for initiating those relations in terms of the construction process. As a multi-sensorial tool, involving both vision and touch, the graphite smudge activated an inimitable forecasting of experiences and practices based on the analogous role between drawing materials and the materials of building.

Smudgy graphite

Borromini's pervasive use of *lapis piombino*, or graphite, was a drawing material of then-recent provenance that had been hardly tested by architects in Rome. Graphite offered a number of advantages over previous drawing materials. Compared to black chalk (*pietra nera*) or charcoal (*carbone*), graphite is very hard, allowing the drawing tool to be brought to a sharp point. It leaves a resolute and penetrating mark that can be smeared or erased, yet it adheres well to textured drawing surfaces.⁴ Having a crystalline structure, it has a dull, reflective quality that causes it to be immediately recognised over the matt surfaces of chalk or charcoal. It was cited for the first time by Johan Mathesius in 1564 as a 'new metal of natural origin, used for writing', and it was initially mined and used primarily in England.⁵ Graphite entered into Roman architects' use only in the latter part of the 16th century, arriving in the pockets of immigrating Lombardy architects and craftsmen.⁶ Although experimenting early in his practice with different drawing materials, Borromini seems to have switched overwhelmingly to the use of graphite, whether sketching, developing designs, or preparing drawings for his patrons.⁷



2—

In spite of his ability to render extremely fine line-work with the material, as evident in some of his early drawings, Borromini relished the capacity of graphite to be smeared, blurred and smudged. A working drawing of a portal threshold for San Giovanni in Laterano (c.1649) shows a number of commonalities in how he utilised the graphite pencil (Fig.2).⁸ As in many of his drawings, a dusty ambience permeates the sheet, most likely to have been caused by handling and the sliding of drawing tools. A second, more concentrated darkening occurs in areas of high line density, such as the left side of the entrance portal, where lines packed tightly together may be used to describe wall *poché* or shade effect, or they may be the result of multiple alterations placed on top of each other. They provide the raw material for the smudge, prompting a range of possible actions. A certain amount of dust is released from the graphite line just by applying multiple lines on top of each other, either for alteration, shading, or both. The discharge and spread of dust is emphasised through the tracking of the hand or drawing tools across the sheet. Normally in his sketches and process drawings, Borromini used a paper with a heavy tooth, creating a secondary texture of brighter, closely spaced lines within the smudges, caused from the raised laid lines in the paper. Although some incidents are consequential to the drawing act, in other places there seems to be deliberate smearing of graphite through the resting of the knuckles on the sheet near areas of heavy alteration, such as around the left-side entry columns. These kinds of marks are rarely observed exclusively and are normally seen concurrently. The extent of the graphite smudge certainly goes beyond any incidental smearing induced by stacking, storing and the rubbing of the sheets, although this certainly contributed, not least, to the light layer of graphite dust that pervades most sheets. The examined drawings stem principally from the Albertina collection, which have a well-documented provenance and do not exhibit any substantial evidence of modification by hands other than Borromini's.⁹ Given the consistency and intensity across his drawing oeuvre, most smudges can be seen as intentional or, at the very least, actively allowed to occur.

Borromini's smudge is generally seen as evidence of a working method that proceeds from rough towards increasingly defined geometrical resolutions. This interpretation follows in a long tradition of linking indeterminate graphic forms to the initial stages of creative thinking in drawing and painting. Leonardo da Vinci advised painters to first compose their figures *grossamente*, or roughly, with a focus on the mental and bodily movements as can be detected in ambiguous forms such as clouds and stains. For Leonardo, 'inventions are seen in smudges [*machie*]' and 'may arouse the mind'; and 'although these smudges were completely lacking the perfection of any part, they did not lack perfection in their movements or other actions.'¹⁰ The preparatory focus on movements and gestures relates to Giorgio Vasari's description of the sketch, or *schizzo*, which he wrote was 'made in the form of a smudge [*macchia*].'¹¹ The close link between the sketch and smudgy lines was strengthened by later theorists, such as Giovan Battista Armenini, who used the terms interchangeably. In his *De' Veri Precetti della Pittura* of 1587, the 'manner of the smudge [*guisa da macchia*]' is a kernel of creative confusion, inviting reworking and repetition.¹² By the 1747 edition of the *Vocabolario della Accademici della Crusca*, the connection between graphite, revisions and smudges is clear: graphite is 'an instrument for making first drafts [*strumento, da formare i primi abbozzi*]' for drawings to be later perfected in ink, but it should not be used for under-drawing, as such lines lead to a 'smudgy drawing [*disegno macchiato*].'¹³

The scholarship on Borromini's graphite stems principally from a 1993 essay on the subject by Joseph Connors.¹⁴ Able to be easily altered and erased, graphite was for Connors highly suitable as a medium for Borromini to work out his innovative architectural forms. Referring to the antique allegory of a mother bear licking her young cub into shape, invoked by Borromini in the dedication of his *Opus Architectonicum*, Connors argued that the architect utilised graphite similarly – as a means to tease out form from formlessness.¹⁵ Scholars have generally followed Connors's analysis, with some important points added. Federico Bellini linked Borromini's use of graphite with his documented use of red wax and clay for making models, believing that these soft materials analogously allowed for easy corrections and revisions.¹⁶

The interpretation of Borromini's creative process in terms of geometrical form has long been a feature of evaluating the complex layering and depth of the architect's drawings, and it continues to do so today with ever more sophisticated digital survey tools.¹⁷ Following Leo Steinberg, who published a highly influential text on the symbolic geometry of San Carlo alle Quattro Fontane (San Carlino) in 1974, it has become commonplace to analyse Borromini's plan by extracting a rigid framework of lines, arcs and circles to discover the underlying geometric apparatus – hidden, as it were, by a cloud of dust.¹⁸ By this method, Borromini's graphite dust is a practical consequence of the inventive search for form; as residue from ghost lines, iterations, or *pentimenti*. It is thus a 'process cloud' to be mentally whisked away in order to discover the architect's true intentions. This critical approach to drawing practice can be traced back to Vasari, who saw a strict line from sketches (*schizzi*) to drawings *in buona forma*, finishing with drawings measured 'with the compasses or by eye [*con le seste o a oc(c)hio*].'¹⁹ From a larger perspective, it can also be a problem of art history's bias in Baroque historiography towards reading the drawings from a formal-aesthetic perspective.²⁰ That Borromini didn't operate within a strict line from formlessness to form is further evidenced by the robust collection of drawings, again highly smudged, that were prepared for his publication project, long after the buildings were finished.²¹

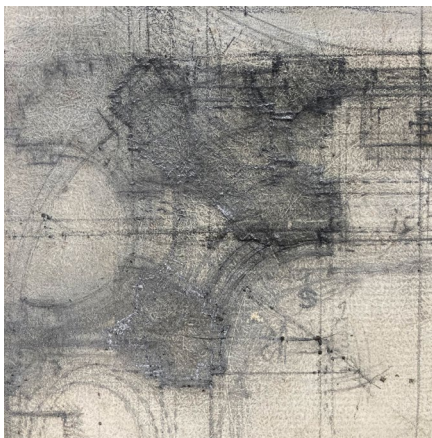
Borromini's unusual and pervasive use of graphite must be seen as more than simply an innovative tool for graphic metamorphosis. Indeed, what is explored below is the notion that the drawing smudges were a protagonist in the material sympathies between the drawing materials and the materials of the building. This assertion stems from the fact that architectural drawings operate as a consonant forecast of construction rather than as a means to tease out visual or pictorial forms.²² The distinction between projective and mimetic drawing is still preserved in the Italian verb *progettare*, 'projecting', referring specifically to architectural design practice, in lieu of the more common derivatives in English of *disegnare* – to design or draw. The careful selection of drawing tools and materials was already linked to architectural practice just a few years before Borromini by Vincenzo Scamozzi, whose treatise, *L'idea della Architettura Universale*, was quite possibly among Borromini's personal library of over 900 books.²³ Furthermore, his immersion in the *Seicento* culture of curiosity and natural science, even to the point of keeping a personal curiosity cabinet, would have opened him to the multi-sensorial and imaginative dimension of materials.²⁴

Borromini arrived in Rome as part of a tradition of immigrating craftsmen from the Ticino region, starting his education directly on the building site of St Peter's under the tutelage of Carlo Maderno.²⁵ His profound technical knowledge of construction and daily interest in the workings of the building site point towards a deeper reading of the graphite smudge, leading one to reasonably ask if such smudges are a constituent component in the imagining of architecture's physical constitution. In this way, rather than an exhaustive search for form, the marks represent a building-up of the project on paper, working in parallel with the imagining of a future building, utilising reciprocal, material sympathies and constructional logic.²⁶

Graphite and *tevolozze*

These assertions can be introduced through a working drawing for the Cappella dei Re Magi, made late in life (c.1660) during the work on the Collegio di Propaganda Fide (Fig.3).²⁷ Graphite smearing permeates the sheet. There are concentrated areas of blackened haze and blurred fields from erasure. Intense over-drawing has compressed the sheet and caused it to buckle in places, recalling the paper's pulpy origin, giving it a solid grey sheen. Copious ghost lines, compass pricks, scale marks and dimension notes are concealed between various beclouded regions. In a detailed look at one of the corners from the upper left (Fig.4), the pressing and concentration of the graphite are easily seen, aided additionally by erasure. The wall thicknesses and profiles are heavily reworked and repeatedly offset, creating a fuzzy, ambiguous condition where surface profiles dissolve into the wall *poché*, and vice versa. Changes and alterations concentrate on localised gestures, such as door-jamb thicknesses and niche profiles. The walls maintain a tightly integrated field of contours: a simultaneity of possible architectures.

3—



4—

This highly localised approach to shaping and profiling offers a contrasting reading to the predominant emphasis placed by scholars on Borromini's meta-level, geometrical compositions. Rather, what seems plausible is that the smears of graphite follow a similar logic to that of the architect's well-documented use of *tevolozze* – the re-used, often fractured, Roman bricks excavated from nearby ruins,²⁸ an integral part of Roman building culture for centuries. Borromini explored the technique in innovative ways through a combination of inflected wall surfaces, niches and sculpted moulding details, utilising *tevolozze* in nearly all of his major building projects.²⁹ Unlike new bricks, which are mediated through an intrinsic construction logic of seriality, regularity and modularity, *tevolozze* are an entirely different material, governed by the anti-shape of fractured



5—

bricks suspended in a matrix of up to 40% mortar.³⁰ Throughout the early modern period, building with *tevolozze* was a common and established building practice, one with specialists in excavation and handling, and generally held building standards.³¹ Together with the intended covering in stucco, discussed at length below, they acted as a material dialectic for constructing ductile walls and mouldable building details. This unique approach is plainly visible in two examples where Borromini's *tevolozze* never received the intended stucco finish: the façade of S. Maria dei Sette Dolori and the *tiburio* of Sant'Andrea delle Fratte (Fig.5).

Under the agency of the graphite pencil dust, walls dissolve into a single, plastic material that can be moulded and kneaded, something similar to Borromini's well-known use of clay and red wax models.³² The art historian Hans Sedlmayer took this inherent plasticity as evidence that 'the material in which Borromini's structures are imagined is not an actual specific material'.³³ However, this is not the moulding of a sculptor freely carving and shaping in a homogenous, compliant material – a re-playing of the hylomorphic supremacy of form over matter.³⁴ Rather, Borromini was working within the limits of his materials. Although the *tevolozze* technique utilises re-used and broken bricks, it is governed by a strict adherence to the regular horizontal coursing enabled by the flattened proportions of Roman bricks. Thick mortar joints absorb the vertical irregularity of the brick, normally between 2 and 4 cm. The emphasis on horizontal continuity is critical for maintaining structural integrity, a point made by Cavalieri San Bertolo in his 19th-century treatise on materials engineering.³⁵



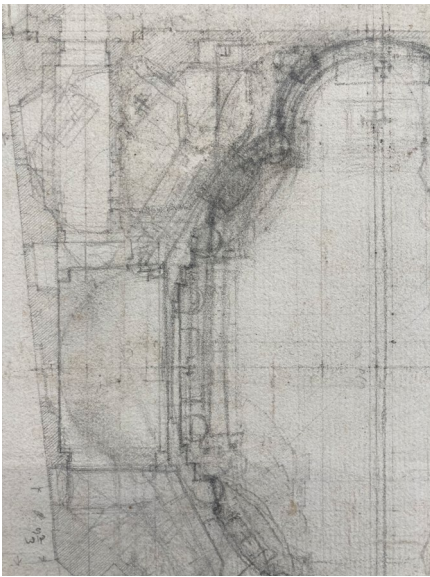
6—

The horizontal order of *tevolozze* is certainly consistent with Borromini's highly inventive approach to developing architecture through planimetric drawing, particularly in moments where the walls are able to be freely rotated, nested, and altered according to highly localised curves and niches. This is reiterated in Borromini's frequent reliance on sweeping, horizontal cornice profiles, often made in *tevolozze*.³⁶ The construction principles can be seen in a detail from Sant'Andrea, where the monolithic treatment of the column, wall and window pediment is governed by a remarkable and evenly spaced horizontal coursing (Fig.6). In fact, the building structure and roughed-out surface relief can be read as an organic whole, built up in hundreds of horizontal layers. This is inadvertently acknowledged by Mario Botta in his full-scale re-creation of San Carlino in 1999, where the horizontal layering of the architecture is expressed in hundreds of layers of stacked wood, nearly identical to *tevolozze* in their vertical coursing dimension.³⁷



7—

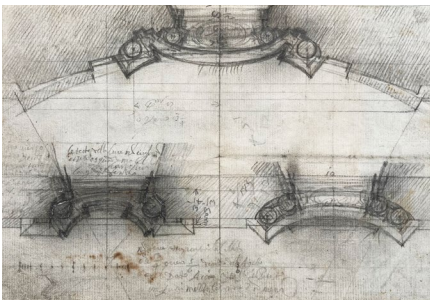
The horizontal coursing, together with its intrinsic anti-modularity, meant that *tevolozze* had certain similarities to ashlar stone construction. Thus, calculating wall areas in re-used bricks was measured more like stone than that of new bricks. In building contracts, a given area of wall in either tufo or *tevolozze* was assigned a nominal thickness, usually one or two Roman *palmi* (22.3 cm–44.6 cm), whereas the same square area in new brick would be calculated strictly by the *testa*, or the width of the brick.³⁸ Furthermore, since in *tevolozze* the logic of the brick as an independent, serial and modular element is negated, the bricks invite themselves, like stone, to be broken, chipped and sculpted. The well-seasoned, hard-fired clay responded well to filing and chipping, and the bricks could be sculpted into rather fine details with a relatively low cost, especially in comparison to specially moulded ones. This can be observed around a detail of the profiling and column orders at Sant'Andrea (Fig.7). Here, terracotta tiles and bricks construct a highly sophisticated under-wall, or *bozzatura*, that becomes practically an art in itself. Many were chipped and formed either *in situ* or as in-progress pieces that were placed immediately after shaping.³⁹



8—



9—



10—



11—

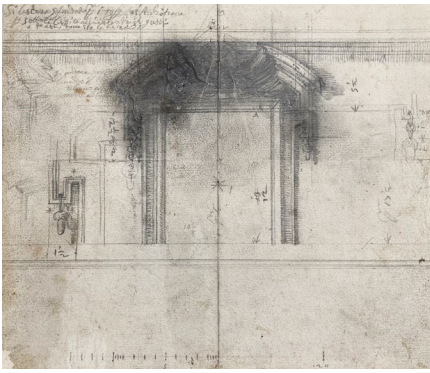
With these conditions in mind – the anti-shape of *tevolozze*, its capacity to be chipped and shaped, and its relation between planimetric drawing and horizontal consistency – we can return to the graphite drawings again. In a working plan drawing for San Carlino from c.1634–38, the multiple, overdrawn lines are conducted free-hand, with a soft graphite pencil, dissolving into a gentle smear that maintains the provisional aspect of the project (Fig.8).⁴⁰ The measured lines and underlying geometric framework, so critical to modern attempts to analyse the plan, are extremely limited.⁴¹ Rather, each inflection, kink or crook in the wall drawing could be read in an analogous way to a possible layer of *tevolozze*, which can also be locally altered in wall thickness or edge conditions. Not only do the graphite lines suggest revisions at a single, horizontal level, there are also multiple levels on top of each other. By this reading, the graphite smudge registers a mental ‘building up’ of the wall following the planimetric order of *tevolozze*. Or, perhaps what we witness is a simultaneous ‘building up’ and ‘building down’, where multiple, horizontal levels above and below are imagined at the same time through a fuzzy, graphite matrix. This is certainly evident in a plan drawing for the campanile of Sant’Andrea delle Fratte (Figs 1, 9), produced around 1657, where heavy graphite over-drawing on one of the four pillar elements recalls the localised plasticity of *tevolozze* employed during the raising and detailing of the surfaces.⁴²

The indeterminate and provisional nesting of fragmented bricks in *tevolozze* parallels an approach to planimetric wall *poché* that dissolves the strict definition between wall thicknesses and edge profiles. Perhaps not surprisingly, then, Borromini’s wall *poché* provides one of the predominant sources of graphite dust throughout his oeuvre. By putting down a broad and even layer of graphite, normally via tightly spaced parallel strokes, the raw material for smudging is freely activated through sliding drawing tools, a dragging knuckle or fist, or the pushing pencil point. This correlation between wall *poché* and *tevolozze* brings new relevance to the deep smudges observed above in the plan for the Cappella dei Re Magi (Figs 3, 4), where edge profiles deliquesce into wall *poché* and vice versa. The contingent character inherent in fuzzy fields of graphite may readily be associated with a spread-out, heterogenous field of flat, broken bricks. A similar phenomenon may be observed, for example, in a study for the entrance to the Collegio di Propaganda Fide (Fig.10).⁴³

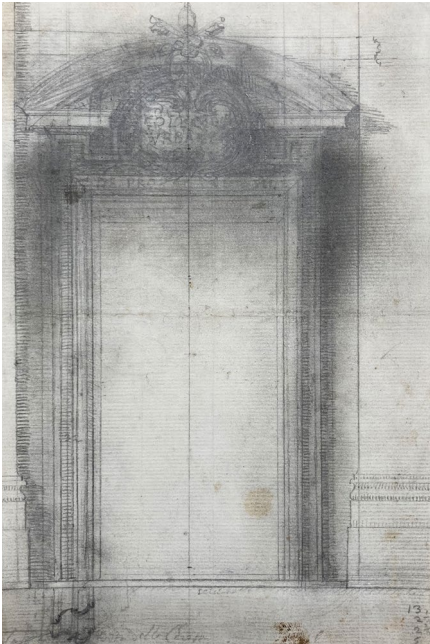
Graphite and *stucco romano*

So far, we have been peering ‘inside’ Borromini’s architecture, analysing the smudges from building footprints and section cuts. A number of the architect’s smudgy drawings, however, are working studies of interior and exterior elevations that were later rendered in stucco. For Borromini’s pervasive white interiors, a special stucco was applied over the *tevolozze*, known as *stucco romano* – a hard, matte wall covering whose signature ingredient is marble dust taken from ruined statues and building elements.⁴⁴ On San Carlino, for example, covering two Roman palmi of *tevolozza* (approximately 45 cm), *stucco romano* consists of two layers: the first of lime and pozzolana between 0.5 and 5 cm thick, and a final, very thin layer of finely crushed lime and white marble dust, between 1 and 4 mm thick (Fig.11).⁴⁵ The walls and vaults thus act as a cohesive construction, where *stucco romano* and *tevolozze* operate as a material dialectic. The variability and fragmentation of *tevolozze* create a strong, mechanical bond with the first layer of stucco, while at the same time the stucco accommodates and invites a plastic approach to the wall surface. In this way, stucco not only ‘covers’ the *tevolozze*, it also demonstrates and expresses it.⁴⁶

These resonances may be introduced through a pair of exterior window and portal studies for the Collegio di Propaganda Fide, executed around



12—



13—

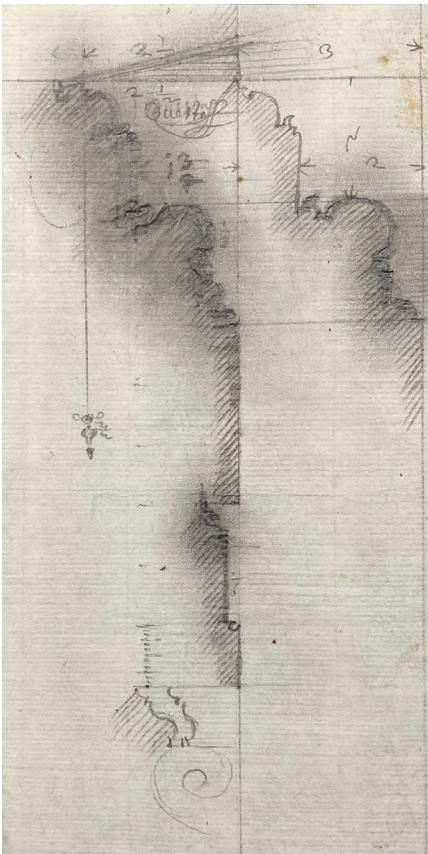


14—

1660–62 (Figs 12, 13).⁴⁷ These sheets are typical of Borromini's later, elevation drawings, where substantial graphite smudging permeates the details and *modénature*, often on heavily toothed paper. The architect's carefully rendered shadow marks and ornamental reliefs disband in the air and provide the raw material for a graphite fog of possible resolutions. In this sense, the same provisional impulse at play with *tevolozze* can be observed also in the working out of stucco details.⁴⁸ In the window study (Fig.12), the re-working is intense enough to crease the paper, leading to a pulpy coagulate of graphite and paper fibres. Upon closer study, it can be seen that much of the graphite smudge is induced by the dragging of the right-hand knuckles, grinding on the sheet and tightly gripping the pencil during scores of markings and re-markings. Almost as a rule, whenever heavy, localised smudging appears, there appears a secondary smudge around 8–10 cm to the right and around 2 cm lower, a result of the resting fist. This means that a deeper smudge on the left is often countered by a softer, more diffuse one on the right, depending on the concentration of the lines being smudged. This consistent smudging by the architect on his own drawings leads one to speculate that, in addition to graphite's many advantages for both presenting and working out a design, there were other motivations.

In comparison with Borromini's shadow hatching (Fig.13), the deliberate and extensive hand smudge is not a render or representation, but it is a real presence of material sympathies *in* the drawing. The drawing dust *is* imagined dust: marble dust of the stucco, dust floating in the air, dust reflected in the sunlight, dust accumulating on the surfaces. It was actually Sedlmayer who first pointed out the dusty feeling of Borromini's white interiors, writing: 'The material often appears dull, dead and dusty.'⁴⁹ But what he reads as blunt and lifeless – a classical association with dust as inanimate flesh – I interpret as vital and potent, following in the beatific experience described by Fra Juan de San Bonaventura, of visitors to San Carlino who 'for some time are seen not to move ...'.⁵⁰ Ever since antiquity, dust or powder has acted as a resilient vessel for associations with intensity and fertility, and the rebirth of matter.⁵¹ We know by remarkable intuition that matter in its powdered state is mysteriously more energetic, conjuring intense reactions and images, from poison to pollen.⁵² The Jesuit polymath Athanasius Kircher, for example, wrote that the final projection (*proiezione*) of the Philosophers' Stone is achieved by harnessing the secrets of powders.⁵³ The Danish painter Vilhelm Hammershøi captured the synchronicity of airborne dust and sunlight, in his *Dust Motes Dancing in Sunbeams* (*Støvkornenes dans i solstrålerne*) of 1900 (Fig.14). Marcel Duchamp and Man Ray's *Élevage de poussière*, or *Dust Breeding*, explored the fertility of falling dust as a locus of passing time. These artworks explore dust as a subtle material, lacking geometry but having atmospheric and spatial extension, manifesting an otherwise transparent medium, such as air and light, and piercing our imagination with powerful associations.

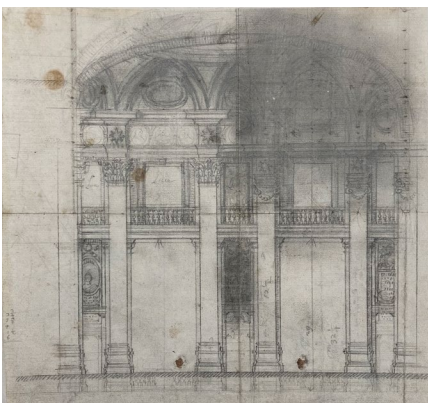
By working deliberately with graphite dust and inducing a play with its qualities, Borromini engages with the multi-sensorial potential of powdered materials such as marble dust. Unlike other drawing materials, such as charcoal or ink, the dry, crystalline shimmer of graphite leads to an obvious sympathy with the crystal matrix of marble, a material property not shared with tufo or travertine, particularly in a powdered state. Marble dust was known since antiquity as one of the primary ingredients in luminous, finish plastering, the others being slaked lime, sand and/or pozzolana.⁵⁴ However, these highly decorative techniques were mostly forgotten and only popularised in Rome in the early 16th century with the discovery of the stucco vault decorations in the Domus Aurea.⁵⁵ Beyond the hard surface and bone-white colour, what made *stucco romano* unique was its link to the antique. 'Use marble from Paro, reduced to dust,' wrote



15—



16—



17—

the great antiquarian Pirro Ligorio, 'which can be easily found among the Roman ruins, or excavated from broken statues.'⁵⁶ Leaving aside the 'ease' by which these antique fragments were so casually pulverised, fashioning a material link to antiquity was nonetheless critical for Borromini.⁵⁷ He conducted surveys of antique buildings and excavations, kept books on antiquity in his library, and was closely associated with some of Rome's leading antiquarians, such as Virgilio Spada and Fioravante Martinelli. The latter was a personal friend and consulted closely with the architect on the ancient sites in his guidebooks to Rome.⁵⁸ White marble dust recovered from antiquity, pervasively utilised in large quantities as in the interiors of San Carlino, Sant'Ivo and San Giovanni in Laterano, would have induced infallible associations with past grandeur.⁵⁹

The relation between dusty materials may be further elaborated at the level of detail in an entablature section study for the Palazzo Falconieri (Fig.15), a tightly-cropped drawing cut away from its original sheet.⁶⁰ The graphite smudges are quite prominent and appear in discrete locations along the profile edge, intensified by the use of parallel shading lines to accentuate the profile in relation to the surrounding ether, inducing a graphite fog that both emanates from and penetrates into the surface. The profiles have been heavily reworked to the point of mollifying the paper. The smudge marks were probably induced by the dragging knuckles protruding from Borromini's tightly-held pencil while overdrawing and hatching, as evidenced by the overall size of the profile, which measures only 15 cm in height. This remarkable drawing seems related to imagining a cornice as a device for producing subtle effects in light and shade.⁶¹ Such cornice profiles, the complexity of which could only be rendered in stucco, appear in the drawing to 'grab hold' of the air – the same attribute, in fact, which has led to an irresistible attraction between San Carlino's crystalline surfaces and the black dust of the modern, polluted city (Fig.16).⁶² Air as a subtle material is activated by Borromini's cupola lantern, from which the heavenly light of the Holy Spirit, represented in the centre of a *camera di luce*, gently descends. This is a stark contrast to Bernini's geometric 'rays', generating chiaroscuro effects through raking light.⁶³ Paolo Portoghesi has described the quivering effect of Borromini's mouldings as a kind of *sfumato*, a reference to the subtle control of light in painting as achieved and theorised by Leonardo da Vinci.⁶⁴ An especially difficult technique requiring expert control of brush and paint, it was palpable but not apparent: it was visible by being invisible.⁶⁵ Whereas Leonardo addressed *sfumato* in relation to pictorial effect, however, Borromini had to forecast such an experience through his moulding and decorative designs. His *sfumato* is therefore constructed, not painted, and transcends the purely visual realm. In this way, the smoky properties of graphite provided an ideal metonymic device for tuning the profile physiognomies to the light and air conditions.

A partial section and interior view of the Cappella dei Re Magi, drawn late in life in 1664 (Fig.17), brings up the question of *sfumato* in the upright view.⁶⁶ The upper right is dominated by a descending, smoky cloud, no doubt due to a heavy fist dragging across the sheet while fiddling with the stucco ornaments in the upper left. A second, more contained smudge dominates the lower, centre niche design. Windows above call out openings for light, designated by the word *luce*. The outspread dust cloud, even on Borromini's terms, is notable, diffusing the surface of the sheet into a multi-sensorial, imagined interior. The pervasiveness is aided by the chromatic consistency of graphite, which is spread around by drawing tools, rubbing sheets, and the hand. The rife diffusion of cloudy marks recalls a contract with *stuccatori* at San Giovanni in Laterano, where the craftsmen were instructed to finish the church 'covered in stucco made from the whitest marble dust, just as much in the large nave as in the

smaller areas'.⁶⁷ By revising, rubbing, and erasing, the profile moulding emerges from the drawing *and* makes its effects present. Rather than representing reality, it *is* reality: dust on the drawing is the marble dust of the stucco; the dust in the air.

'Pasty' materials

We have been ruminating on the smudgy qualities of Borromini's graphite marks, drawing parallels between drawing materials and building materials. This has been argued from two points of view. On the one hand, the contingency of the homogenous graphite smear is brought into parallel with the provisional capacity of building walls from thick mortar paste and left-over brick fragments – *tevolozze*. On the other, the dry and crystalline emanations of graphite dust are brought into sympathy with the doughy mix of lime and marble dust that constituted Borromini's signature surface finish – *stucco romano*. These three materials, graphite, *tevolozze*, and *stucco romano*, in spite of each having their own material logic, are all characterised by a high degree of pliability and suppleness. Taken together, they defy the rigid, geometric schema by which Borromini's work is normally evaluated, emphasising instead the generative potential of drawing materials and techniques in a complex dialectic between imagining and building. Yet, in resisting the intransigence of form, the materials of the drawing and the building are linked through a substantial intelligibility, each having concrete practices and associations.

The shared, matrix-like quality of these materials is perhaps at the root of common understandings of Borromini's architecture as 'uniform', 'cohesive', 'monochrome', or a 'single mass'. Borromini himself apparently wished, on several occasions, for an architecture made of a single piece or body.⁶⁸ Or perhaps it was John Evelyn who pointed us in this direction when he visited the newly completed San Carlino interior and recorded in his diary: 'Here we enter'd the Church of St. Carlo, a singular fabrique for neatness as built all of a new white stone...'.⁶⁹ In our geometrically conditioned mind, these are intelligible descriptions. But does that starve us of the full range of possible material images? A retrospective look at Borromini's smudge shows how a rock-solid approach to geometrical form might be softened through drawing to conceive of architecture as a constituent, material body. We see that the graphite smears respond to the provisional logic of the architect's building materials while at the same time instilling a resonance with the dry, pliable atmosphere that results from their encounter with the light and dust in the air.

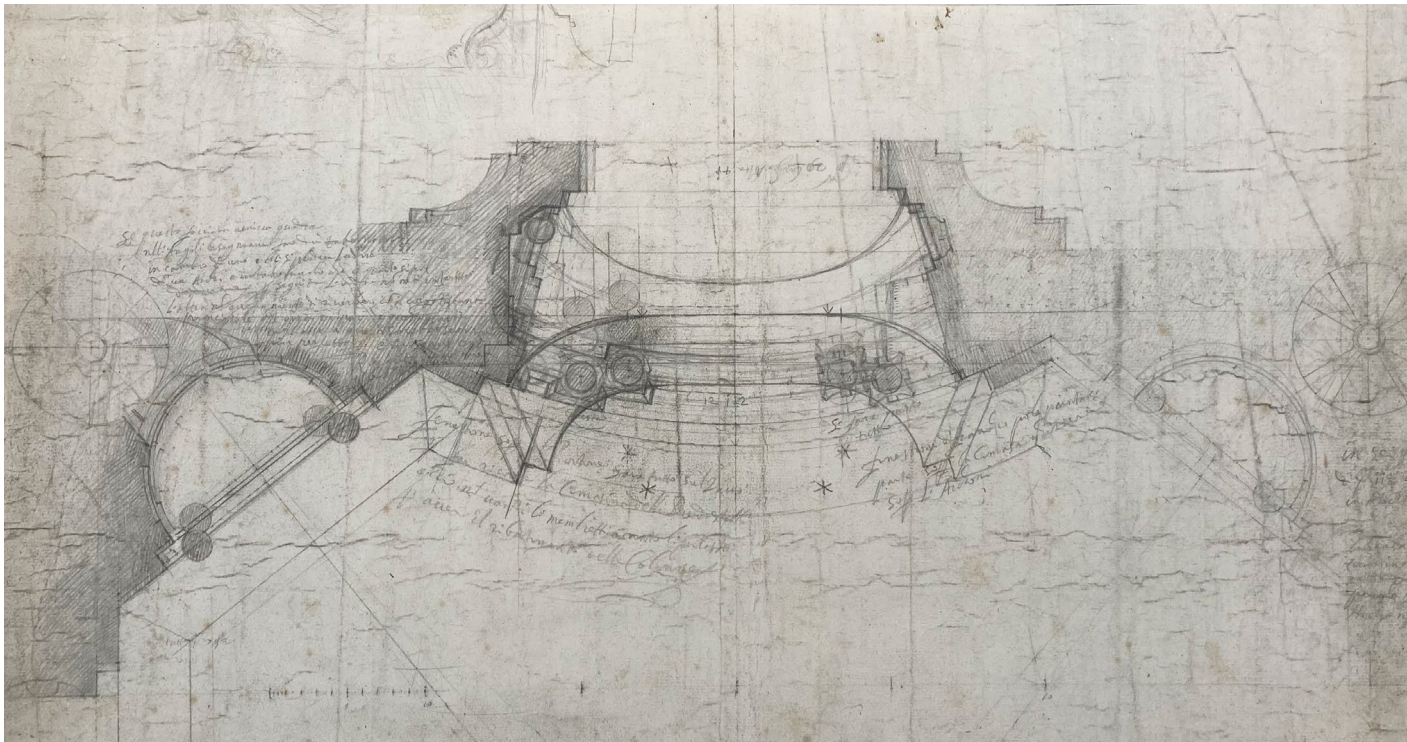
In his 1933 treatise on the imagination of the small and invisible, *Les Intuitions atomistiques*, the scientist-philosopher Gaston Bachelard challenged us to moderate our hardened, logical view of the world, viewing the materiality of dusts and powers as a key to unlocking our material intuitions. In this way, we engage the depth of reality by disassociating surfaces from geometrical lineaments and seeing them in their substantial reality: 'In lieu of a world of geometrically well-defined solids,' he remarked, 'let us imagine a world of pasty objects.'⁷⁰ This was actually suggested for Borromini's architecture in a 1907 essay by the art historian Max Dvořák. Remarking on the architect's mouldings, he asserted that they twist and bend like 'dough [*Teig*]', an observation arising from the 'total architectural picture [*architektonisches Gesamtbild*]' of Borromini's spaces.⁷¹ Maybe, when this is taken as a flash of material intuition rather than visual metaphor, Dvořák was on to something. To build an architecture that invokes associations with powders and pastes, Borromini had all the right materials, both in his drafting hand and on the building site.

- 1 'Itane in geometriae pulvere haerebo?', Seneca, *Epistle* 88.39.
- 2 This approach is well summarised by Federico Bellini, 'Dall'ideazione al cantiere', in *Borromini e l'Universo Barocco. Catalogo*, ed. Richard Bösel and Christoph L. Frommel (Milan: Electa, 2000), 349–351.
- 3 An account left by a Trinitarian father for San Carlo alle Quattro Fontane summarises Borromini's work: 'He guided the builder's shovel, the plasterer's darby, the carpenter's saw, the stonemason's chisel, the brick-layer's trowel and the iron-worker's file, with the result that the quality of the work is high but not the cost ...', from Anthony Blunt, *Borromini* (London: Penguin Books, 1979), 84.
- 4 On the advantages of graphite over other drawing materials in the *Seicento*, see Federico Bellini, *Le Cupole di Borromini: La 'Scienza' Costruttiva in Età Barocca* (Milan: Electa, 2004), 110, n.26. Borromini also used graphite to draft letters, see *La Fabbrica della Sapienza: l'Università al Tempo di Borromini*, ed. Orietta Verdi (Rome: Croma-Università degli Studi Roma Tre, 2015), no.17, 102ff.
- 5 Johan Mathesius quoted in Joseph Meder, *Die Handzeichnung: Ihre Technik und Entwicklung [with plates]* (Vienna, 1923), 140. On graphite in early modern drawings in general, see *ibid.*, 140–147; Annamaria Petrioli Tofani *et al.*, *Il Disegno: Forme, Tecniche, Significati* (Cinisello Balsamo, Italy: Silvana Editoriale, 1991), 227ff.; Paul Emmons, *Drawing Imagining Building: Embodiment in Architectural Design Practices* (New York: Routledge, 2019), 171–178.
- 6 On graphite via Milanese masters to Rome, see Nicola Soldini, 'Milano 1619', in *Francesco Borromini: Atti del Convegno Internazionale, Roma, 13–15 gennaio 2000*, ed. Christoph L. Frommel (Milan: Electa, 2000), 33–39 (34); and Heinrich Thelen, 'Sui disegni di Borromini', in Bösel and Frommel, *op. cit.*, 65–74 (64).
- 7 Thelen, *ibid.*, 65.
- 8 AzRom 377 (Collection of the Albertina Museum, Vienna). For recent bibliography see Paolo Portoghesi, *La Vita e le Opere* (Milan: Skira, 2019), XCI, 453 and Bösel and Frommel, *op. cit.*, cat.XII.19, 233.
- 9 Borromini burned many of his publication drawings before dying by suicide, but hundreds of process drawings survived and were preserved by his nephew, Bernardo. They were acquired by the antiquarian Phillip von Stosch in 1730 and auctioned off to the Royal Imperial Court Library in Vienna in 1769, being eventually absorbed into the Albertina collection in 1919. See <https://www.albertina.at/en/research/architecture/history/>. Aside from an occasional script in the hand of Stosch or Bernardo, there is little or any indication of smudging by agents other than Borromini. See Heinrich Thelen, *Francesco Borromini. Die Handzeichnungen*, I, 2 vols (Graz: Akademische Druck- und Verlagsanstalt, 1967), I, 75–82.
- 10 Leonardo da Vinci, 'Trattato di Pittura', in A. Phillip, *Treatise on Painting (Codex Urbinas Latinus 1270)*, 2 vols (Princeton, NJ: Princeton U.P., 1956), vol.2, fol 62r. See analysis in Philip Sohm, 'Maniera and the Absent Hand: Avoiding the Etymology of Style', *RES: Anthropology and Aesthetics*, 36 (1999), 100–124 (123).
- 11 'Gli schizzi ... sono fatti in forma di una ma[c] chia', Giorgio Vasari, *Le Vite de' più Eccellenti Pittori Scultori ed Architetti*, ed. Gaetano Milanesi, 9 vols (Florence: G.C. Sansoni, 1906), 1, 117. See entry for 'macchia' in Filippo Baldinucci, *Vocabolario Toscano dell'Arte del Disegno* (Florence, 1681), 86.
- 12 Giovan Battista Armenini, *De' veri Precetti della Pittura* (Ravenna: Tebaldini, 1587), 72.
- 13 See entry for *Piombino*, in *Vocabolario degli Accademici della Crusca* (Naples: Giovanni di Simone, 1747), 3, 373. Also described in 1606 as a tool for first lines in Henry Peacham, *Art of Drawing with the Pen* (London: Richard Braddock, 1606), 10; originally cited in Emmons, 173.
- 14 Joseph Connors, 'Die Revolution des Graphits', in *Von Bernini bis Piranesi: Römische Architekturzeichnungen des Barock*, ed. Elisabeth Kieven and Joseph Connors (Stuttgart: Hatje, 1993), 33–38. See also Joseph Connors, 'Un Teorema Sacro: San Carlo alle Quattro Fontane', in *Il Giovane Borromini: dagli Esordi a San Carlo alle Quattro Fontane*, ed. Manuela Kahn-Rossi (Milan: Skira, 1999), 459–474 (464ff.).
- 15 Connors, 'Revolution', *op. cit.*, 38; and Connors, 'Teorema', *op. cit.*, 465. The allegory was invoked by Borromini in the dedication page of his *Opus Architectonicum*: Francesco Borromini, *Opus Architectonicum*, ed. Joseph Connors (Milan: Il Polifilo, 1998), 3.
- 16 Bellini, *Le Cupole*, *op. cit.*, 102–104.
- 17 Andrew Saunders, *Baroque Topologies* (Modena: Palombi Editori, 2018), 110–118.
- 18 Leo Steinberg, *San Carlo alle Quattro Fontane: A Study in Multiple Form and Architectural Symbolism* (Ann Arbor: UMI, 1974), 15–42. The importance placed on the plan geometry of San Carlino has been explored recently in Michael Hill, 'Practical and symbolic geometry in Borromini's San Carlo alle Quattro Fontane', *Journal of the Society of Architectural Historians*, vol.72, no.4 (2013), 555–583; Marco Canciani, 'Il disegno della cupola del San Carlino alle Quattro Fontane dei Borromini: ovale canonico?', *Disegnarecon*, vol.8, no.15 (July 2015), 12.1–12.22; Skender Luarasi, 'Toggling through San Carlino: A speculative inquiry into the geometry and process in San Carlino and its interpretations in history', in *Finding San Carlino*, ed. Adil Mansure and Skender Luarasi (London and New York: Routledge, 2020), 25–48.
- 19 Vasari, *op. cit.*, 1, 117ff.
- 20 Werner Oechslin, 'On Borromini's drawings and "practical geometry": voleva dentro una cosa cavare un'altra, e nell'altra l'altra senza finire mai' in *Finding San Carlino*, 8–24 (17); Vlad Ionescu, 'Architectural Symbolism: Body and Space in Heinrich Wölfflin and Wilhelm Worringer', *Architectural Histories*, 4 (1) (2016), article 10, 1–9 (1).
- 21 On drawings for publication, see Martin Raspe, 'The final problem. Borromini's failed publication project and his suicide', *Annali di Architettura*, 13 (2001), 121–136.
- 22 That architects' drawings differ from those of painters begins with L.B. Alberti in *De Re Aedificatoria*, II. i; Raphael and Castiglione in their letter to Leo X write that, unlike painters' drawings, architects' drawings must have 'tutte le misure giustamente', in *Lettera di Raffaello d'Urbino*, ed. Pietro Ercole Visconti (Rome, 1840), 31; see also Vincenzo Scamozzi, *L'Idea della Architettura Universale*, 2 vols (Venice: Presso L'Avtore, 1615), 1, 41.
- 23 Scamozzi, *ibid.*, 1: 49–52; Carolina Dayer, 'Spelling ink: Vincenzo Scamozzi and the magical practice of tinting architecture', unpublished manuscript. On Borromini's library, see Paolo Portoghesi, 'La Biblioteca di Borromini', *La Festa delle Arti*, no.1 (2014), 358–365 (358) and Joseph Connors, 'Borromini's House of Books', *Annali di Architettura: Rivista del Centro Internazionale di Studi di Architettura Andrea Palladio*, no.31 (2019), 135–144.
- 24 See Filippo Camerota, 'Le bizzarrie dell'ingegno: architettura e scienza per villa Pamphili' in Bösel and Frommel, *op. cit.*, 297–311; Antonella Romano, 'Les jésuites dans la culture scientifique romaine (1630–1660)' in *Francesco Borromini: Atti del Convegno Internazionale*, 329–334. Connors explores connections between Borromini and the so-called *virtuosi* in Connors, 'Revolution', *op. cit.*, 36ff. On Borromini's relation to curiosity cabinets, see Bösel and Frommel, *op. cit.*, cat. II.1, 24.
- 25 Pierluigi Silvan, 'Il Borromini alla fabbrica di San Pietro e l'ascesa romana' in *Il Giovane Borromini*, 367–386.
- 26 Vitale Zanchettin, 'Building accounts as architectural drawings. Borromini's construction practice and the role of Francesco Righi', in *Practice and Science in Early Modern Italian Building*, ed. Hermann Schlimme (Milan: Mondadori, 2006), 113–124 (113); Thelen, 'Sui disegni di Borromini', *op. cit.*, 72; Oechslin, *op. cit.*, 17.
- 27 AzRom 889. For recent bibliography see: Bösel and Frommel, *op. cit.*, cat.XVIII.12, 307ff., and cat.XXI.24, 347; Connors, *Von Bernini bis Piranesi*, 35 and cat.16, 76ff; Portoghesi, *La Vita*, *op. cit.*, 319ff.
- 28 On *tevolozze* in the *Seicento*, see Nicoletta Marconi, "'Muro fatto di tevolozze": laterizi di reimpiego nei cantieri di Roma barocca' in *Demolire, Riciclare, Reinventare: La Lunga Vita e l'Eredità del Laterizio Romano nella Storia dell'Architettura*, ed. Evelynne Bukowiecki, Antonio Pizzo and Rita Volpe (Rome: Edizioni Quasar, 2021), pp.65–74; Elisabetta Pallottino, 'Costruire in laterizio nell'area romana tra XVI e XIX secolo: produzione, apparecchi, vocazione estetica', *Archologia dell'Architettura*, XX (2015), 75–78. Vitruvius comments on the superior strength and water resistance of re-used, ceramic roof tiles (*tegulae*) in Vitruvius, *De Architectura*, II.8.19. Compared with new bricks, *tevolozze* was less expensive, but it was often more expensive than alternatives in tufo. *Tevolozze* was praised for its durability and resistance to water intrusion, and was quite common in foundations.
- 29 Borromini would have directly observed the use of *tevolozze* at Carlo Maderno's building site of San Pietro in 1620. On brick re-use in the early modern period, see Pier Nicola Pagliara, 'Materiali, tecniche e strutture in architetture del primo Cinquecento', in *Storia dell'Architettura Italiana: Il Primo Cinquecento*, ed. Arnaldo Bruschi (Milan: Electa, 2002), 522–545 (531ff.).
- 30 On plasticity of *tevolozze* in Borromini's architecture, see Bellini, *Le Cupole*, *op. cit.*, 284ff., and Marconi, *op. cit.*, 72.
- 31 See Marconi, *op. cit.*, 65–67. Technical treatises of the 19th century codified long-established practices: Nicola Cavalieri San Bertolo, *Istituzioni di Architettura Statica e Idraulica*, 3 vols (Naples, 1869), II 78ff. and III 352; and Giuseppe Valadier, *L'Architettura Pratica*, 1829–39, 5 vols (Rome: Sapere, 1992), III 252–254 and fig.CCXIV.
- 32 Bellini, *Le Cupole*, *op. cit.*, 102–104. This connection is analysed recently in Matthew Mindrup, *The Architectural Model: Histories of the Miniature and the Prototype, the Exemplar and the Muse* (Cambridge, MA: MIT Press, 2019), 162ff. Red wax, clay and wood models were recorded in Borromini's death inventory, *La Fabbrica della Sapienza*, 95–101.
- 33 'Die Materie, in der die Gebilde Borrominis gedacht werden, ist kein bestimmter wirklicher Stoff', Hans Sedlmayer, *Die Architektur Borrominis*, facsimile of 1939 edition (Zürich: Georg Olms Verlag, 1986), 93.
- 34 The common analogy of Borromini to a modeller (e.g. Bellini, *Le Cupole*, *op. cit.*, 182; Connors, 'Revolution', *op. cit.*, 35) should be taken with scepticism.
- 35 'Tutto lo studio, nella composizione de' muri di *tevolozza* dev'esser rivolto ad ottenere appunto la perfetta orizzontalità dei filari ...', Cavalieri San Bertolo, *op. cit.*, 78. See also Marconi, *op. cit.*, 66.

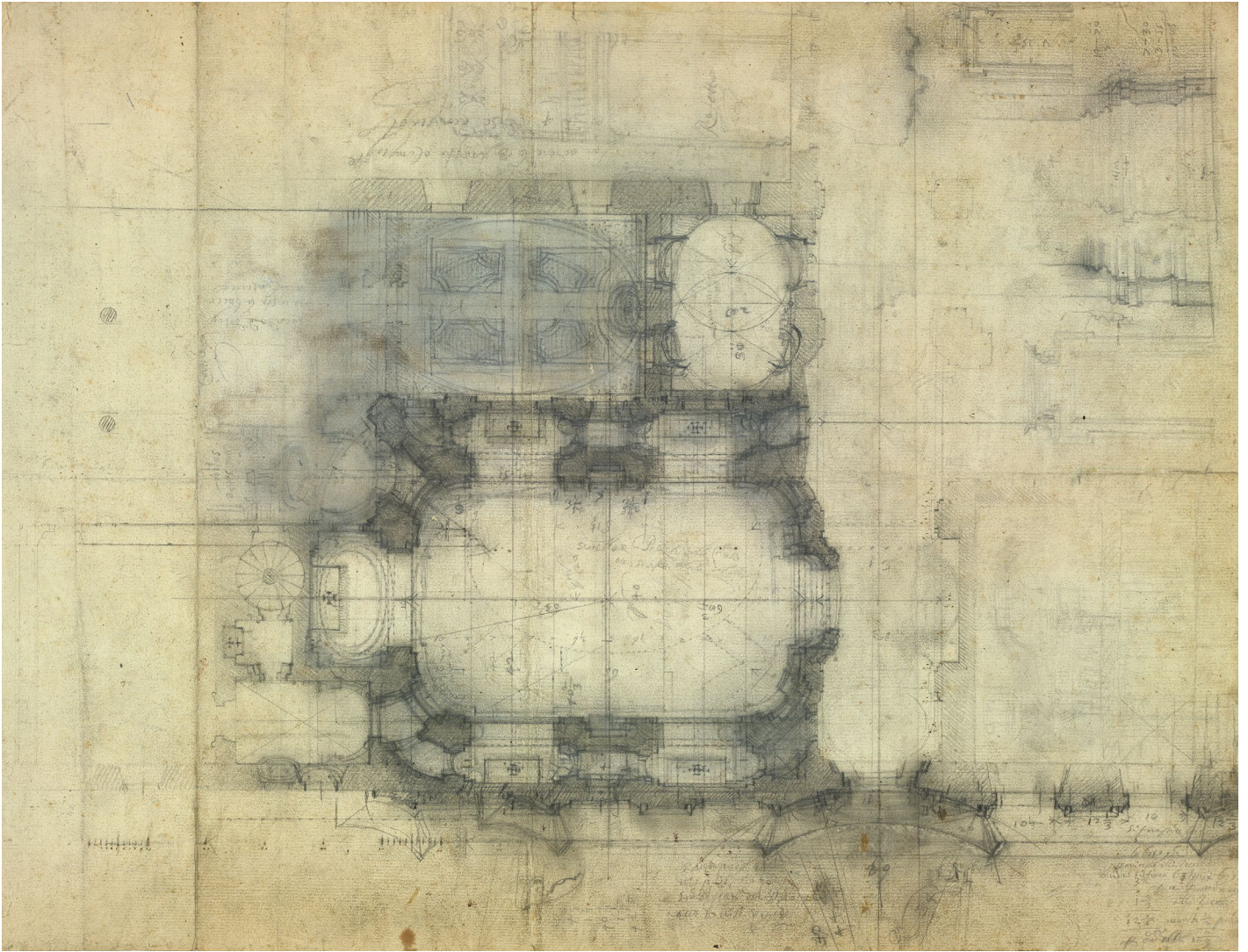
- 36 On Borromini's cornices, see analysis in Portoghesi, *La Vita*, *op. cit.*, 537–539.
- 37 The wood layers are stacked 5.5 cm on-centre; by comparison the *tevolozze* on Sant'Andrea are about 6 cm on-centre vertically. Mario Botta, 'Appunti sulla rappresentazione lignea del San Carlo a Lugano', in *Borromini sul Lago*, ed. Gabriele Cappelato (Milan: Skira, 1999), 13–20 (17ff.).
- 38 Marconi, *op. cit.*, 71.
- 39 Bellini, *Le Cupole*, *op. cit.*, 283–287 (285).
- 40 AzRom 171.
- 41 The rigid geometrical framework by which this plan is normally discussed is probably based on drawings prepared by Borromini much later. The San Carlino plan sequence was analysed by Connors in Bösel and Frommel, *op. cit.*, 110, and Bellini, *Le Cupole*, *op. cit.*, 139–147. The relation between idealised geometry and project execution was taken up by Hill, who suggests a middle ground, see Hill, *op. cit.*, 561ff.
- 42 AzRom 114. For recent bibliography see: Bösel and Frommel, *Borromini: Architekt im barocken Rom*, *op. cit.*, cat.XVII.12, 524; Portoghesi, *La Vita*, *op. cit.*, 330ff. See also Vitale Zanchettin, 'Il tiburio di Sant'Andrea alle Fratte: propositi e condizionamenti nel testo borrominiano', *Annali di Architettura: Rivista del Centro Internazionale di Studi di Architettura Andrea Palladio*, no.9 (1997), 112–135 (123ff.). See also the concept of the *cantiere verticale* in Bellini, *Le Cupole*, *op. cit.*, 63ff.
- 43 AzRom 915.
- 44 On *stucco romano* in general, see Sergio Bettini, "'Opus tectorium", "opus albarium", "gypsum". Note sullo stucco romano tratte dalle fonti antiche', in *L'Arte dello Stucco in Friuli nei Secoli XVII–XVIII: Storia, Tecnica, Restauro, Interconnessioni*, ed. Giuseppe Bergamini (Udine: Udine Musei, 2001), 75–86; Federico Bellini, 'Lo stucco. Con note alle tecniche di Vitruvio, Vasari e Giocondo Albertolli', *Rassegna di Architettura e Urbanistica*, vol.35, no.103/104 (Jan/Aug 2001), 91–103. Domenico Fontana, Carlo Maderno and Borromini (all Ticinese) were trained in the art of stucco, see Tommaso Manfredi, 'La presenza di architetti e maestranze ticinesi nel sistema dell'edilizia pubblica a Roma da Sisto V a Urban VIII', in *Il Giovane Borromini*, 209–229.
- 45 Maria Alessandra Petretto, 'Le indagini endoscopiche: contributo agli studi sulla cupola e sulle strutture murarie della chiesa', in *La 'Fabbrica' di San Carlino alle Quattro Fontane: Gli Anni del Restauro*, ed. Paola Degni (Rome: Istituto poligrafico e Zecca dello Stato, Libreria dello Stato, 2008), 199–207.
- 46 In the 16th century there is an increasing emphasis on the quality of the *bozzatura* – walls that are specifically designed to receive stucco, see Pagliara, *op. cit.*, 526 n.24.
- 47 AzRom 918 (window), see Bösel and Frommel, *op. cit.*, cat.XVIII.23, 313. AzRom 909 (portal).
- 48 These exterior details would not receive *stucco romano* but rather a lime-pozzolana-based stucco finished off with a finely ground whitewash in travertine, as was typical for the *Seicento*. See Elisabetta Pallottino, 'Stucchi in esterno. La nuova scabrosità delle superfici nell'architettura del Seicento romano. Precedenti di una tecnica borrominiana tra Como, Genova e Roma', in *Il Giovane Borromini*, 315–321 (316).
- 49 'Das Material wirkt oft stumpf, tot und staubig', in Sedlmayer, *op. cit.*, 95.
- 50 Portoghesi, *La Vita*, *op. cit.*, 534.
- 51 Images of the imaginative potency of dust and powders are well summarised in Steven Connor, 'Pulverulence: The power of powder', *Cabinet*, no.35 (Fall 2009), 71–77.
- 52 Gaston Bachelard, *Les Intuitions atomistiques* (Paris: Boivin, 1933), 28–32.
- 53 Anna M. Partini, Pasquale Faccia and Athanasius Kircher, *Athanasius Kircher e l'Alchimia: Testi Scelti e Commentati* (Rome: Edizioni mediterranee, 2004), 98, 192. Borromini's personal connection with Kircher has been explored in John Hendrix, 'Francesco Borromini and Athanasius Kircher', in *Neoplatonism and the Arts*, ed. Liana de Girolami Cheney and John Hendrix (Lewiston, 2002), 133–148 (134).
- 54 See marble-dust stucco recipes from ancient and early modern authors, in Carla Arcolao, *Le Ricette del Restauro: Malte, Intonaci, Stucchi dal XV al XIX Secolo* (Venice: Marsilio, 2001), 73–115.
- 55 On the Domus Aurea and 16th-century projects in *stucco romano*, see Maura Bertoldi, Maria Cristina Marinozzi *et al.*, 'Le tecniche edilizie e le lavorazioni più notevoli nel cantiere romano della prima metà del Seicento', *Ricerche di Storia Dell'Arte* (1983), no.20, 77–124 (97–104).
- 56 'Marmo di Paro, ridotto in polvere, lo si trova facilmente fra le rovine romane, oppure lo si recava da statue rotte.' See Bertoldi, Marinozzi *et al.*, *op. cit.*, 116 n.123; Pirro Ligorio's full recipe is reproduced in Arcolao, 103ff.
- 57 Borromini's re-use of antique materials included re-using entire building elements, see Martin Raspe, 'Borromini e la cultura antiquaria', in Bösel and Frommel, *op. cit.*, 46ff.
- 58 *Ibid.*, 46–47; Stefano Fogelberg Rota, 'Fioravante Martinelli's Roma ricercata', in *Rome and the Guidebook Tradition*, ed. Anna Blennow and Stefano Fogelberg Rota (Berlin/Boston: De Gruyter, 2019), 163–196 (167ff.).
- 59 Torsten Tjarks, 'Monochromie und Material als Bedeutungsträger in den Architekturen Borrominis', *Zeitschrift für Kunstgeschichte*, no.82 (2019), 377–399 (390–392).
- 60 AzRom 1061. Connors, 'Revolution', *op. cit.*, cat.17, 78; Portoghesi, *La Vita*, *op. cit.*, 498, no.CLXXXII; Bösel and Frommel, *op. cit.*, cat. XXII.28, 367 (attributed to Sant'Andrea delle Fratte).
- 61 Portoghesi, *La Vita*, *op. cit.*, 535–537; Michael Hill, 'Sunlight in San Carlino', *AA Files* 74 (2017), 59–69.
- 62 Daniela Luzi, 'Gli apparati architettonici e decorativi all'interno della chiesa', in Degni, *op. cit.*, 209–222.
- 63 Fabio Barry, 'Lux and lumen: the symbolism of real and represented light in the Baroque church', *Kritische Berichte*, vol.4 (2002), 22–37 (25).
- 64 Portoghesi, *La Vita*, *op. cit.*, 535.
- 65 Alexander Nagel, 'Leonardo and sfumato', *RES: Anthropology and Aesthetics*, 23 (1993), 7–20 (14ff.).
- 66 AzRom 906. See Bösel and Frommel, *op. cit.*, cat.XVIII.13, 308. Portoghesi, *La Vita*, *op. cit.*, 320ff.
- 67 'Coprendo di stucco con polvere di marmo bianchissimo ... tanto nella Nave grande, quanto nelle Navi piccole', Archivio di Stato di Roma (ASR), Archivio Spada, vol.192, f.156, referenced in Augusto Roca De Amicis, *L'Opera di Borromini in San Giovanni in Laterano: Gli Anni della Fabbrica (1646–1650)* (Rome: Dedalo, 1995), 106.
- 68 See references in Augusto Roca De Amicis, 106; Connors, *Opus Architectonicum*, *op. cit.*, 87.
- 69 Esmond Samuel De Beer, *The Diary of John Evelyn*, 6 vols (Oxford: Clarendon Press, 1955), 2:242 (12 November 1644).
- 70 Bachelard, *op. cit.*, 24.
- 71 Dvořák was cited by Dagobert Frey in 1924, who was in turn cited by Sedlmayer in his 1930 monograph. This obscure citation was revived once again in a recent essay by Werner Oechslin, who spurned the statement because it overlooked the precision of Borromini's architectural process: Oechslin, *op. cit.*, 18.



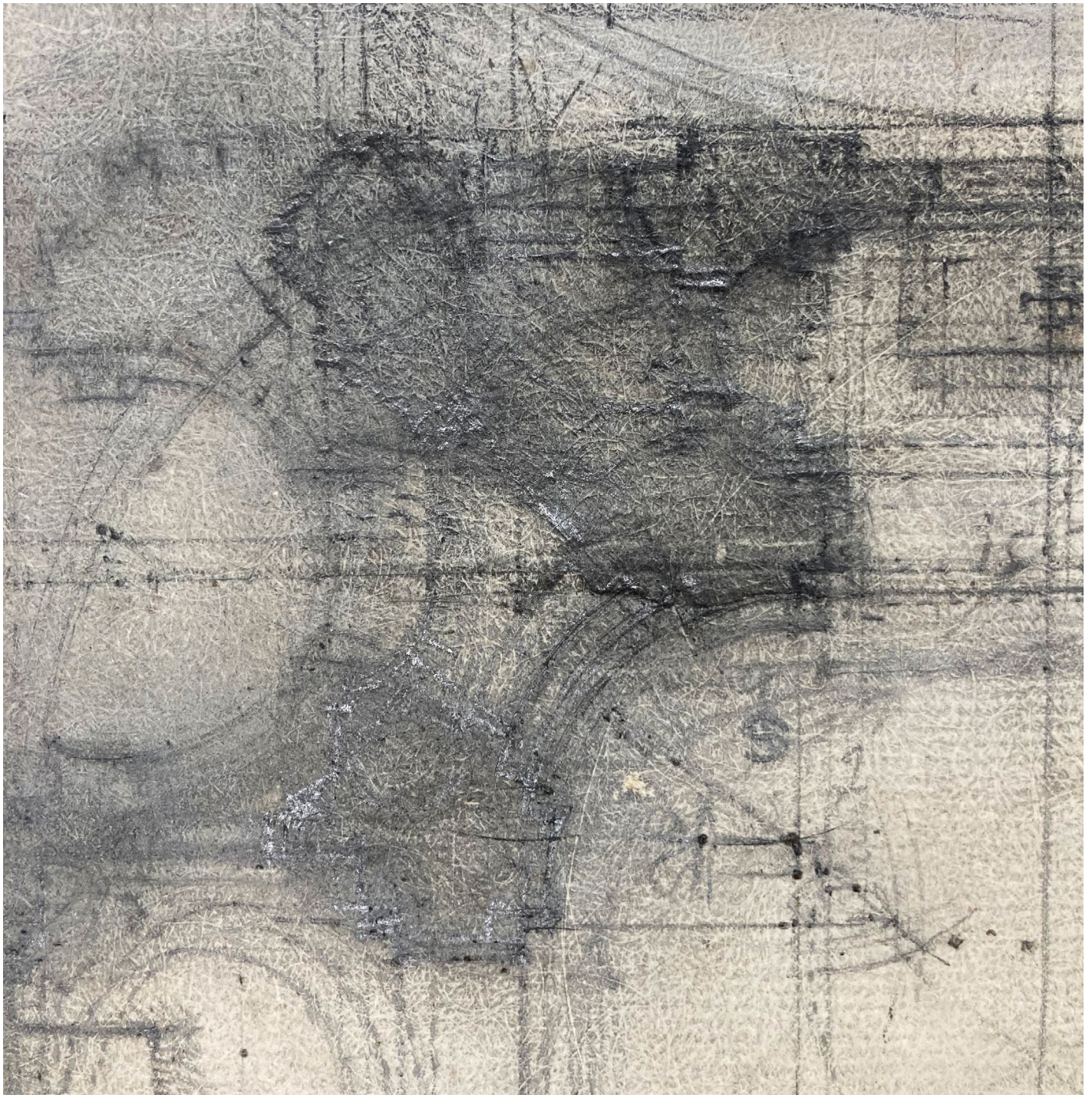
Francesco Borromini, Plan of campanile, Sant'Andrea delle Fratte, Rome, c.1657. Graphite on paper, 26.7 x 19.5 cm. AzRom114, The Albertina Museum, Vienna.



Francesco Borromini, Plan of entrance wall, San Giovanni in Laterano, Rome, c.1649. Graphite on paper, 32.7 x 61.7 cm. AzRom377r, The Albertina Museum, Vienna. Photograph by the author.



Francesco Borromini, plan of Cappella dei Re Magi, Rome, c.1660. Graphite on paper, 49.5 x 66.6 cm. AzRom889, The Albertina Museum, Vienna.



Francesco Borromini, plan of Cappella dei Re Magi, detail, c.1660. Graphite on paper, 49.5 x 66.6 cm. AzRom889, The Albertina Museum, Vienna. Photograph by the author.



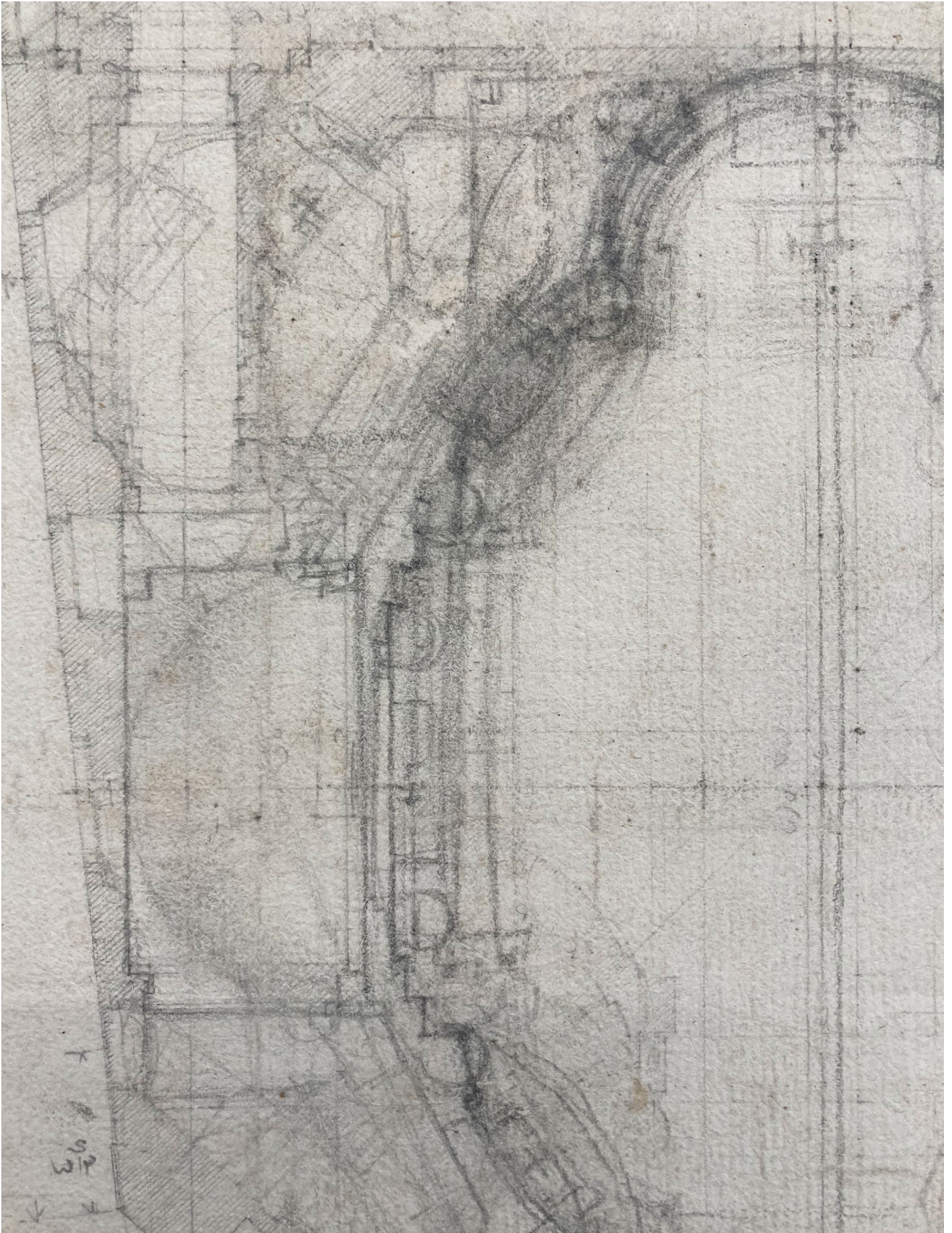
Francesco Borromini, exposed *tevolozze*, campanile and tiburio, Sant'Andrea delle Fratte, Rome.
Photograph by the author.



Francesco Borromini, exposed *tevo/ozze*, detail of tiburio, Sant'Andrea delle Fratte, Rome.
Photograph courtesy of the Biblioteca Hertziana.



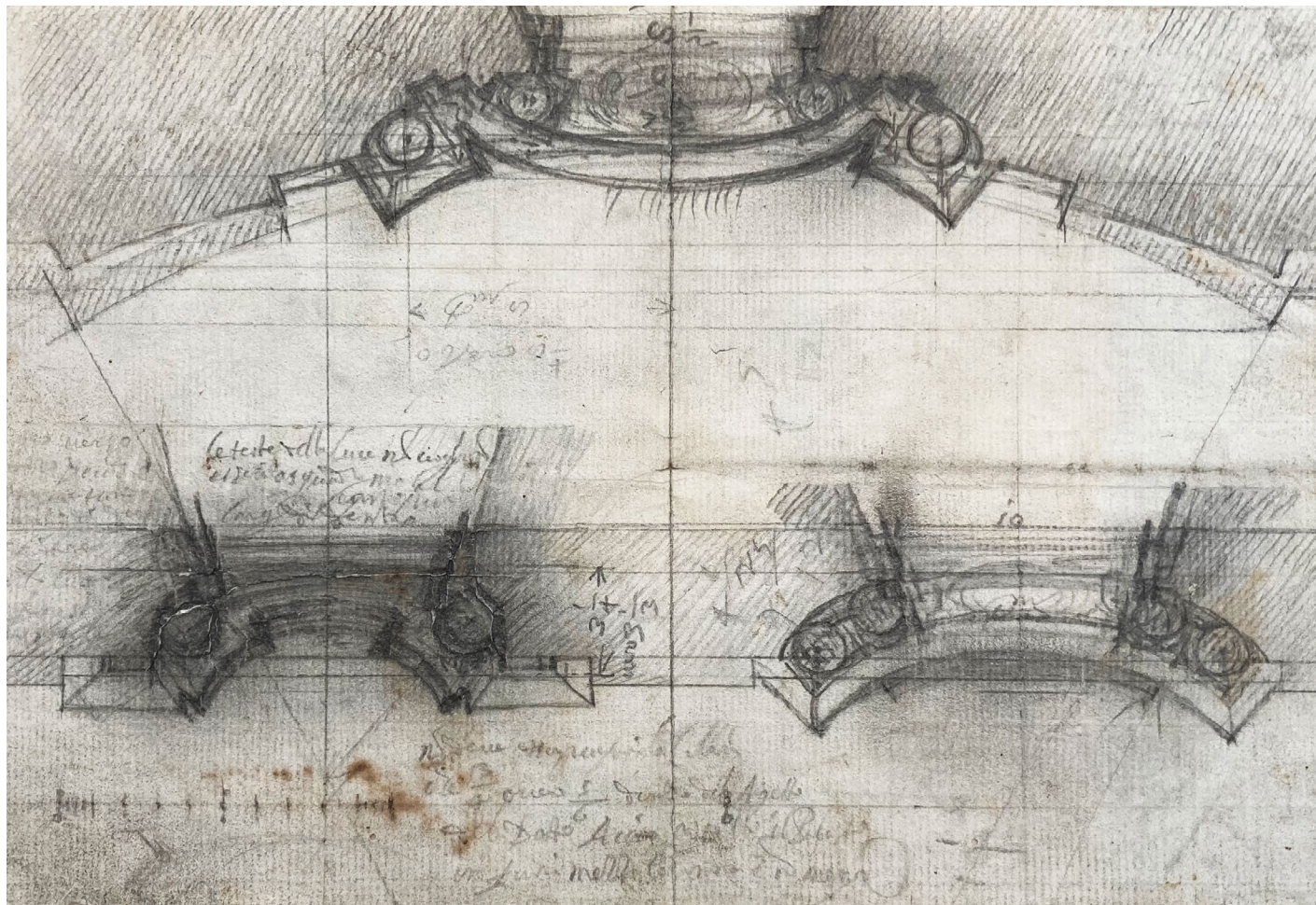
Francesco Borromini, chipped and sculpted *tevo/ozze*, detail of tiburio, Sant'Andrea delle Fratte, Rome.
Photograph by Federico Bellini.



Francesco Borromini, plan detail, San Carlo alle Quattro Fontane, Rome, c.1634–38. Graphite on paper, 52.3 x 37 cm. AzRom171, The Albertina Museum, Vienna. Photograph by the author.



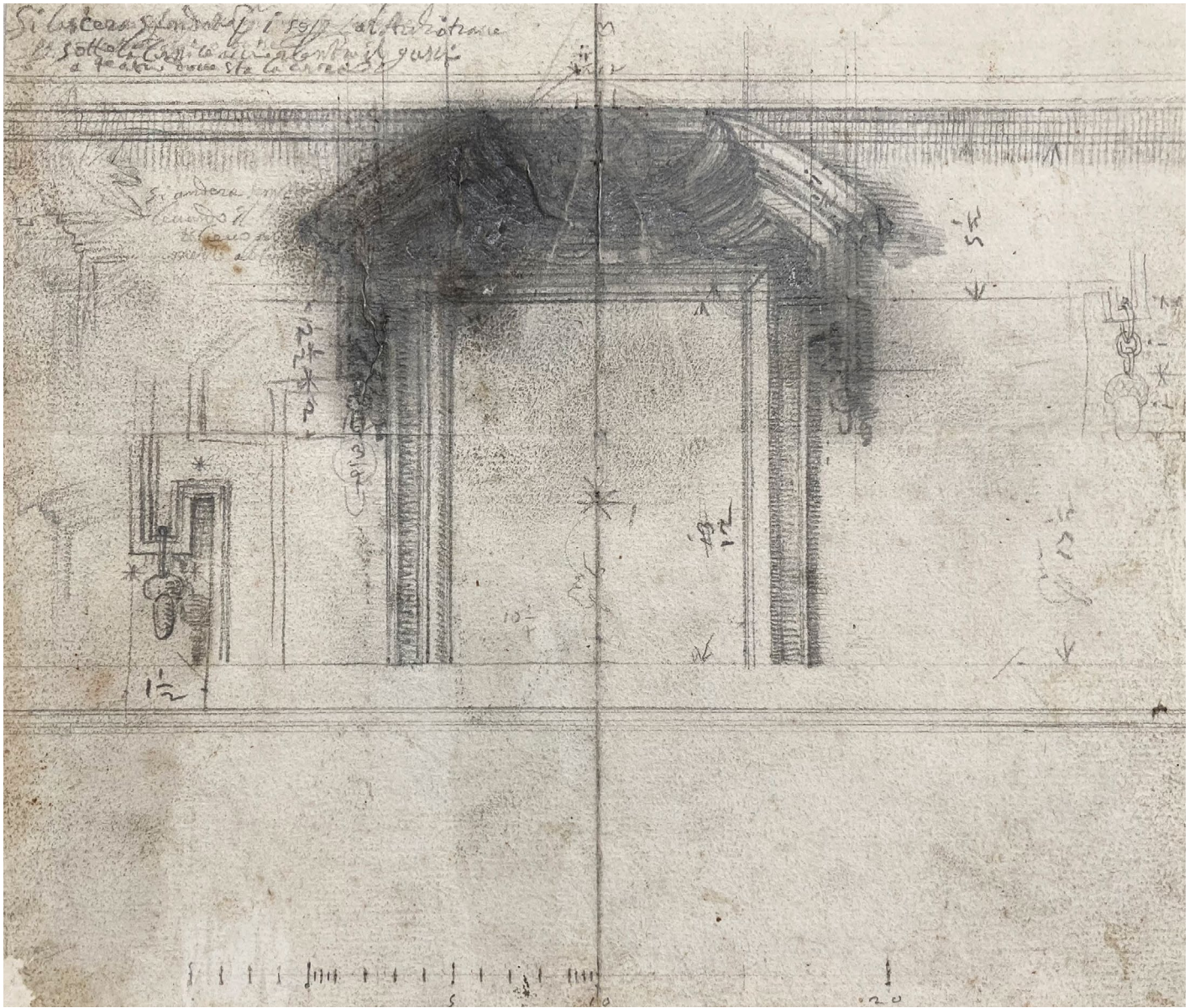
Francesco Borromini, plan of campanile, Sant'Andrea delle Fratte, Rome, c.1657. Graphite on paper, 26.7 x 19.5 cm. AzRom114, The Albertina Museum, Vienna. Photograph by the author.



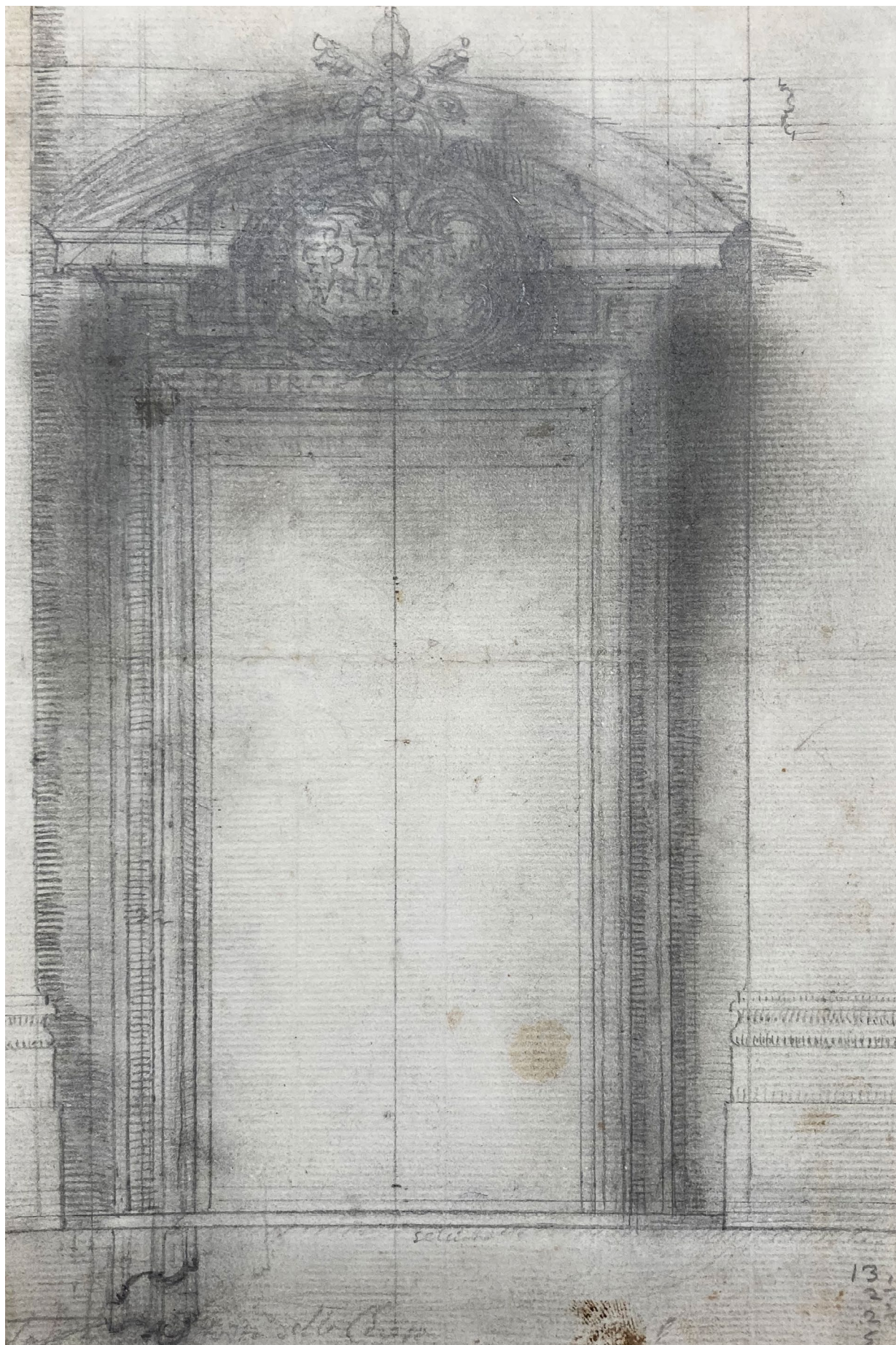
Francesco Borromini, entrance to Collegio di Propaganda Fide, Rome, c.1660–62. Graphite on paper, 16 x 24.7 cm. AzRom 915, The Albertina Museum, Vienna. Photograph by the author.



Francesco Borromini, *stucco romano*, San Carlo alle Quattro Fontane, Rome. Photograph by the author.



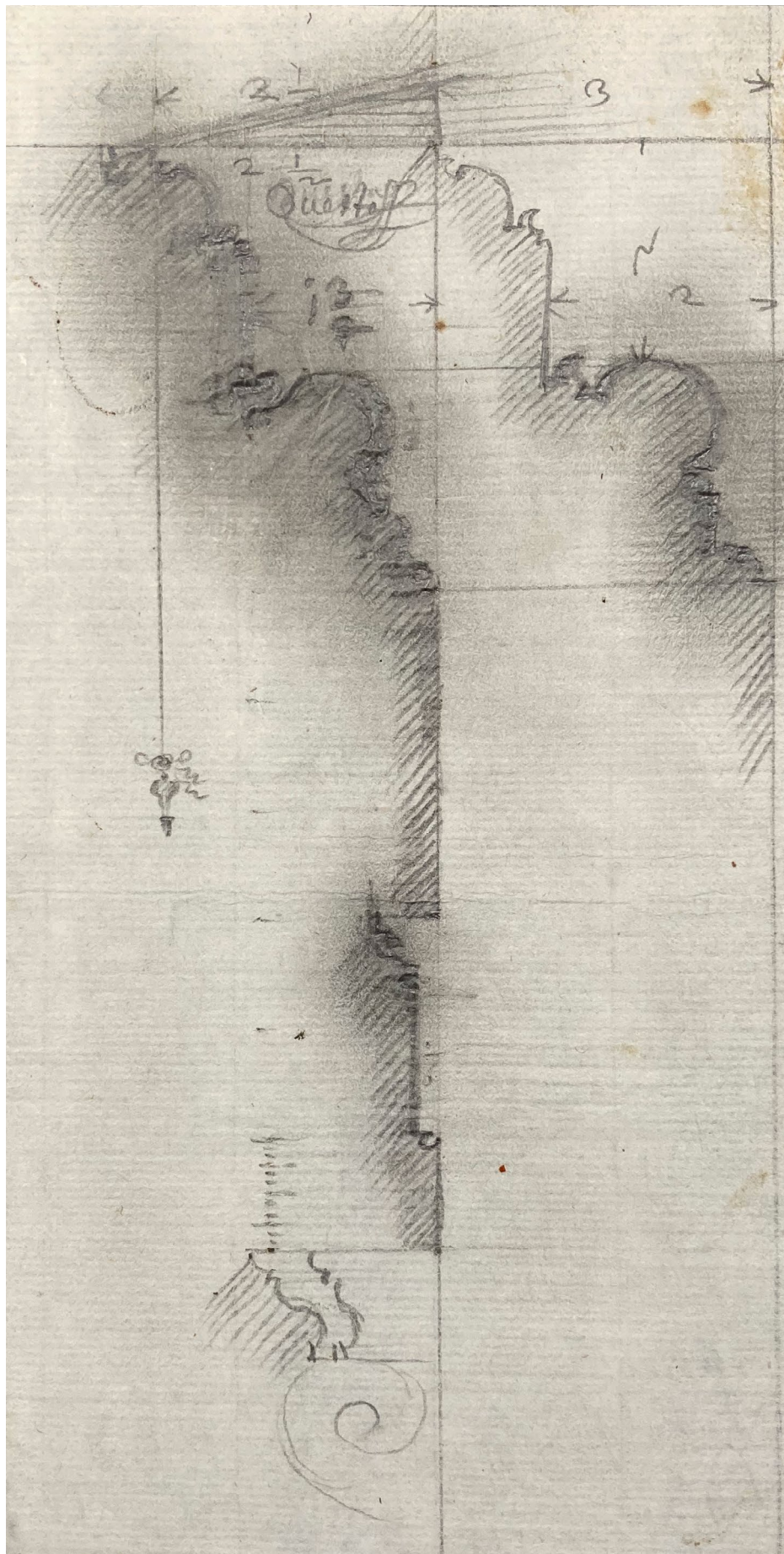
Francesco Borromini, facade window, Collegio di Propaganda Fide, Rome, c.1660–62. Graphite on paper, 21.4 x 25.5 cm. AzRom918, The Albertina Museum, Vienna. Photograph by the author.



Francesco Borromini, main portal, Collegio di Propaganda Fide, Rome, 1662. Graphite on paper, 24.6 x 16 cm. AzRom909, The Albertina Museum, Vienna. Photograph by the author.



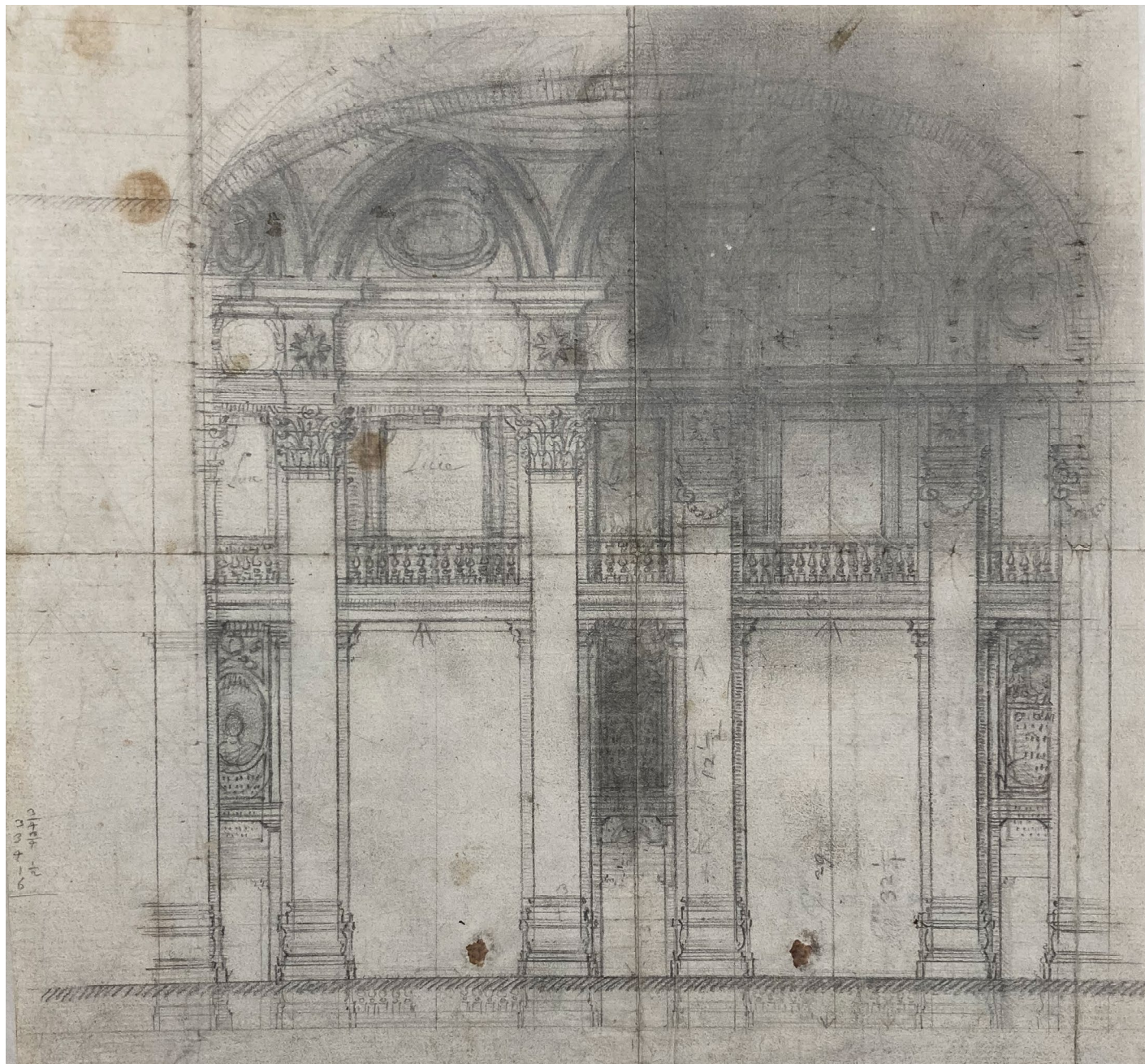
Vilhelm Hammershøi, *Støvkornenes dans i solstrålerne* (*Dust Motes Dancing in Sunbeams*), 1900. Oil on canvas, 70 x 59 cm. Ordrupgaard Museum, Denmark.



Francesco Borromini, cornice section, Palazzo Falconieri. Graphite on paper, 22 x 11.2 cm. AzRom1061, The Albertina Museum, Vienna. Photograph by the author.



San Carlo alle Quattro Fontane, pre-restoration, 1990. Photograph courtesy of Soprintendenza Speciale Archeologia Belle Arti e Paesaggio di Roma.



Francesco Borromini, section-elevation, Cappella dei Re Magi, Rome, 1664. Graphite on paper, 26.7 x 27.5 cm. AzRom906r, The Albertina Museum, Vienna. Photograph by the author.