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Guarino Guarini and his Grand Philosophy of Sapientia and Mathematics

Abstract. This paper proposes that there is a wide and important wealth to the philosophy and art of Guarino Guarini, and one of the keys to these matters lies in the structure and content of his *Architettura civile*, his posthumously-published treatise on architecture. Guarini was an important mathematician in the development of calculus, and his fame is not just that of an architect, perhaps the most learned that Europe has ever thrown up.

Introduction

The purpose of this contribution to Guarinian studies is to establish the ulterior or ultimate meaning of this complex figure of the High Baroque, which has not been fully dealt with previously, leading to even wayward results in the literature. So this will be an exploration of the hermeneutical significance of the polymathic attributes of the Theatine architect, who was also a theologian, an area in which he did not publish, as well as an encyclopaedic writer on philosophy, mathematics and astronomy.

As Joseph Mazzeo put it, the breakdown of hermeneutics in Biblical exegesis, has been followed by a reverse movement – ‘the secularization of *hermeneutica sacra* and its amalgamation to *hermeneutica profana* open the way to two opposing tendencies in modern humanistic and literary interpretation, the sacralization of the secular and the secularization of the sacred’ [Mazzeo 1978, 24]. Three hundred years ago, such confusion was impossible, and age-old conventions were in place to secure man’s place in the world, mainly through a cosmology which was being questioned, of course, but only by an elite. In the time of Milton, everyone was an artist in the sense of participating in thought and enquiry, so that he could call Galileo ‘the Tuscan artist’. An encyclopaedic survey of optics and perspective was entitled the ‘Great Art of Light and Shadow’ (Athanasius Kircher SJ, *Ars magna lucis et umbrae in decem libros digesta*, Rome, 1646). The liberal arts still reigned as the introduction to philosophy both moral and natural (the *trivium*) as well as mathematics (the *quadrivium*). The human mind was a reflection of the cosmic order under neo-Platonic-Aristotelian norms, shared by the great artists and architects of the Baroque, especially the only one who was also a scholar and mathematician: Guarino Guarini (1624-1683). Due to the breakdown in pre-understanding necessary to consider Guarini after his death with the rise of modern science, a fresh effort must be made to restore the conditions to read this Baroque figure as he deserves to be read. Only since 1970 has this Theatine priest, a member of the Clerks Regular who practised as a court architect in Turin where he built the astounding Chapel of the Holy Shroud, been recognised on a par with the architects Bernini and Borromini. The young Guarini studied in Rome where the others were then flourishing, and presumably the novitiate studied these masters in detail.

An attempt has already been made to construct a connection between *Guarini artista* and *Guarini scienziato*: Marcello Fagiolo’s ‘La *Geosofia* del Guarini’ [1970] presumed to explicate Guarini’s thought *more geometrica*. As Guarini seems to have made no change

to the traditional divisions of the applied arts or sciences, geometry as understood by Fagiolo cannot be given the same basis of equality with philosophy and astronomy that he proposed. Rather for Guarini there are three contiguous worlds in the arts – Philosophy, Mathematics and Medicine – the first and last featuring in his *Placita philosophica* [1665]. The main deficiency of Fagiolo's treatment of Guarini's science is the absence of the transcendental dimension of his Universal Mathematics, and its alignment with metaphysics, made clear in the opening pages of his *Euclides adauctus*. If Guarini reorganised the speculative sciences in terms of Universal Philosophy, he remained content with the traditional model for the arts, and here, too, the ordering followed an order both philosophical and cosmographical – in a word, traditional. For Guarini, Philosophy referred to morals, law and the world of secondary causality, Mathematics is either Macrocosmic or Universal, (transcendental), or Microcosmic, the traditional mixed sciences, and Medicine, the amelioration of our human frailty, as he put it, 'for all arts depend either on Mathematics, or on Philosophy, or on Medicine; because all sciences contemplate either things of similitude, or of proportion, or of convenience'.¹ To further articulate Guarini's *scientia scientiarum*, we must be guided by his portrayal of reality in the *Placita philosophica*, and the consequences of the cosmological model found there. The phenomenon of rotundity in the *Placita philosophica* is matched by the astronomical activities of the celestial bodies, the terrestrial change of generation and corruption is measured by the gnomonical operations of solar horology, both activities further treated mathematically in the Theatine's astronomical works. Finally, the whole structure has its conclusion in *quadratura* – squaring the circle – and transformation, where Guarini's two elements of earth and water suffer further mutation into aberrant forms of the mundane natural world either through monstrous development or through the force of human imagination: this last interpretation is based on clues from the mathematical works of Mario Bettini SJ, (1582-1657, the mathematical writer from Bologna, who produced the most graphic and encyclopaedic presentation of Baroque mathematics, but without algebra), Guarini's use of various methods of projection, many found in Bettini, coupled with a careful reading of his treatise *Architettura civile*.² It should be noted that Guarini referred to squaring-the-circle in his *Euclides adauctus*, but did not confirm any method to do so. However, in accord with Fagiolo's presentation, Guarini was insistent in reconciling Universal Mathematics, a pure system as outlined by Euclid and others, with theology, consistent with certain moves to maintain certainty between theology and mathematics developed in Rome in the late sixteenth century.

To sum up at this stage, here is an overview of Guarini's 'grand' philosophy;

- The reconciliation of Plato and Aristotle;
- Scholastic dialectic plus *experientia* or experiment;
- Universal Mathematics linked to light and the Triple Worlds of Early Christian cosmology (the planetary world, the mundane world, and the underworld);
- Hierarchical understanding of Light from the Divine through the image of the Trinity, through cosmic generation and mundane activity, to Aristotelian corruption.

It is grand because of its dependence on Classical realism and Christian exemplarism, its inclusiveness with respect to dialectic as the basis of discovery, hence Guarini's rejection of Parisian physico-mathematics, as mathematics traditionally was never a basis for causality, which it was becoming under Galileo and Descartes. As well as dialectic,

Guarini was also deeply involved in light, as *vincula et via* – a way and a chain, hinting at both Christian and Classical participation – the ‘way’ of St John’s Gospel and Homer’s ‘golden chain’ of light. Regarding this last point, Guarini is unique among writers of *cursi philosophi* of the period 1570-1670 in addressing himself so diligently to the topic of light, and this aspect of his intellectual personality did have important recognitions in his iconography and mathematics, as we will see below. I have demonstrated his use of proportional projection based on the perspectival ladder elsewhere [McQuillan 1991], which supports the design of the dome of the Chapel of the Holy Shroud, Turin (fig. 1).

Fig. 1. The dome of Guarini’s Chapel of the Holy Shroud in Turin

As already indicated, it is my claim that the *Architettura civile* faithfully reflects this structure of reality reflected in the sciences, for architecture represented by the geometry of Vitruvius – the Vitruvian trio of projection, the first two, ichnography (the footprint of the building), and orthography (parallel projection) are developed, and scenography is remodelled by Guarini, much as he dismissed it in his *Euclides adauctus*, 1671, a mathematical encyclopaedia. To enter fully into such an interpretation, I will therefore discuss each *trattato* or section of the treatise in turn.³

The treatise on architecture

Trattato I established the discipline in its parts, paying some cognisance to Vitruvius in assembling in outline various graphical techniques, which ascend in a chain of intellectual dependency until the apex is reached in Geometry, but with the proviso: *L’Architettura, sebbene dipende dalla matematica, nulla meno e lia un’arte adulatrice, che non vuole punto per la ragione disgustare il senso* [Guarini 1968: Tr. I, Cap. III, 3].

Under *Principi di Geometria necessari all'Architettura*, a condensed introduction to Euclid, he then introduced the propaedeutic content, a complete *précis* of both rational and irrational proportion. Thus by bringing proportion to the forefront, Guarini achieved in the *Architettura civile* what he failed to do in the more hidebound treatment of mathematics that is the *Euclides adauctus*. In this spirit he affirmed that *L'architettura pu correggere le regole antiche, e nuove inventare* [Guarini 1968: Tr. I, Cap. III, *Oss. Sesta*, 5].

The second trattato, *Della Ichnografia*, is for Vitruvius the first part of *dispositio*. Already in Trattato I, Cap. II, Guarini warned that: *Il Disegno o Idea, secondo Vitruvio, ha tre parti, delle quali la prima dicesi Ichnografia, chela descrizione ed espressione in carta di quello che dee occupare la fabbrica, che si disegna nel piano* [Guarini 1968, Tr. I, 2]. In Euclidean terms this is the line describing the figure; in ontological terms this is the creation of the angels and light on the First Day, and the activity of the soul proceeding from its divine origin; in architectural terms this is the plan and its figuration, which Guarini explores through diverse parts such as stairs and colonnades. This also requires the knowledge of constructing regular figures such as the pentagon and hexagon, in that order. Here the oval and ellipse are also introduced, as well as his argument with the oblique architecture of Caramuel de Lobkowitz, the egregious Cistercian and Spanish count-bishop, where the Theatine discussed circular colonnades.⁴

The third and longest trattato is by far the most instructive as against the more pedantic nature of what comes before and after, as here is found his treatment of the orders. Entitled *Della Orthografia Elevata*, in terms of the Euclidean generation of form, this represents the development of three-dimensional form first from projected elements, and then through their rotation or projection. As Guarini says in its first chapter, *Onde la ortographia certe prime tiene delineazione, diversee forme le sue idee e sono in generale, sorte di sporti detti Projectiones* [Guarini 1968: Tr. III, Cap. I, 73]. Carboneri provides an explanation from antiquity: *Cvr anche Svetonio (De vita Caesarum) che definisce l'ortographia "Formula, ratioque scribendi e Gramaticis instituta* [Guarini 1968: 113]. In ontological terms this represents the production of planar corporeity, and thus Guarini discussed the orders and the articulation of associated arcades and walls – what was also called *ordonnance*. The successor to orthography, central projection (stereography in the *Euclides adauctus*), now appears as linear perspective (*CAPO VIGESIMOPRIMO, Del rendere proportionata la prospettiva che sembra difettosa per cagione della vista*), a discussion of how various optical effects are contrived. This is followed by more oblique architecture, ending with vaults, *la principale parte delle fabbriche*,⁵ which in effect was his anticipation of the content of Trattato IV, as the beginning of Trattato III makes clear: *Due sorte di ortografia deve speculare l'archetto; dir per due sono le ortographie, una sielevata, l'altra si chiama depressa; di questa ne scriveremo nel trattato sequente; ora solamente delle prima siano per discorre*. In terms of his cosmological structure, *ortografia elevata* would correspond to the perfect corporeity of the celestial bodies, its influential light and the parallel projection of sunlight, and is therefore related to the perfect ordering of the Orders; the next stage, dealing with vaults, indicated a lower level of embodiment and the introduction of vault construction would thus exploit the full corporeity of crassitude.

In Trattato IV, *Dell'Ortografia Gettata*, Guarini immediately indicated this increased corporeity by relating the utility and necessity of Architecture to the French command of the cutting of stones, *la coupe des pierres* or stereotomy, none of which words he used in the text. Here of course the operations are parallel projection, but the operations are

similar to those required for gnomonics, in the scribing on whatever plane sunlight falling on any orientation of dial.

The last trattato was *Geodesia* (Geodesics), and the title of its first chapter openly declared its theme: *Delle trasformazione delle superficie piane rettilinee in altre uguali* – metamorphosis and transformation. This theme was underlined by the Bettinian subject of isoperimetry in Cap. VII. Thus Guarini established the first stage of transformation, to be followed by proportional geometrical progression (Cap. VIII) where the progression of forms to infinity can be made equal to a given area, an analogous process to isoperimetry. While such theory, he roundly declared, was not necessary to the architect,⁶ it was presumably included to enable the conscientious reader, i.e., one who has also read the *Euclides adauctus*, to follow the St. Vincentian material which constituted *Capo Nono: Della quadrazione, spartimento, ed accrescimento geometrico del circolo* – Gregorius de St. Vincent SJ (1584-1667), who was the well known contemporary circle-squarer who failed in this task.⁷ This implied the normal processes of physical development, generation, gnomonical increase or dilation, isoperimetrical equivalence, division and the illusive quadrature, where Guarini threw in a number of simple methods with little elaboration. At last the usual conics of the ellipse, parabola and hyperbola were treated in various forms of transformation and quadrature, all of which are adduced from the *Euclides adauctus*.

The other theme that ran through Trattato V was division, the division of a figure or of land in order to measure the totality of the figure, as geodesics was sometimes defined. This for Guarini meant the final process of mathematical investigation, division to infinity that could only be completed by physical means, i.e., consummation through fire. This may well represent the cycle of elemental transformation, which will be terminated at the end of the world, evoking both the mundane transformation of becoming (the Heraclitan elemental cycle to and from fire) and the teleological destiny determined for the world in Christian eschatology, before the appearance of the new heaven and the new earth of the Apocalypse.

Guarini and Baroque intellectual culture

His Universal Philosophy, and above all his Universal Mathematics, mean much more than the overworked application of 'universal' that was applied to any field of contemporary study embodying conventional encyclopaedic intentions. Not only trained in dialectics and versed in the still, for him, contemplative tradition of mathematics, he was thus heir to these two most distinctive forces in European culture, exactly at the time when these forces were being expressed as never before, in the attempt to create a *mathesis universalis*. While the historical outcome of the period must be judged to have been almost mortally deleterious to the authenticity of these traditions, Guarini was undoubtedly aware of the main lines of the ongoing attack, especially when he rejected the 'physico-mathematics' of the Paris school, of which he had first-hand acquaintance. Nevertheless, within his self-imposed constraints of writing manuals and the bounds imposed by the ecclesiastical and secular powers, Guarini did leave ample evidence of what his world meant, but which, because of the intervening change in our intellectual culture, now requires such effort to recover. Thus his philosophy and mathematics were framed in the old-fashioned didactic manner of his age, time-honoured in the highest way, and his architectural treatise, in contrast, was most unusual but necessarily part of his philosophical world. For Guarini theory and practice were quite separate and only connected, if at all, by the possibility of the arts' communicating essences *demonstrative*

or *ostensive*. His interest in astronomy and gnomonics in his examination of the great Book of the World is properly reflected in the Book of the Soul, and can be approached by that paradigm of all Books, the Bible. This is implicit in his *Physica* where proof from scripture is so useful, guaranteeing its universal validity, and its access to truth. As for his mathematics, its ultimate justification must be found in Denys the Areopagite, which accounts for the activities of the 'miraculous Mathematicians' in theological, and therefore the most absolute, terms. These miraculous mathematicians, *contra* Wittkower [Wittkower 1975: 186], are the angelic mediators between the Divine and the human mind, a doctrine well presented in the *Placita*, but ignored or misunderstood by every commentator so far.

Hans Georg Gadamer [1986] has reminded us that mimesis – cosmic mimesis – is still the greatest force in the world of art, and this is what Guarini, in common with all great traditional art, has achieved in his architecture. While a study of his remaining churches lies outside the scope of the present study, it is possible to relate the major parts of the buildings to such an understanding, far more convincing than the weak appeal to 'open-work structures' that was advanced by Pommer [1967], and echoed by almost everyone thereafter. The other noteworthy aspect of their design is the presence of 'proportional projection' in the geometrical consideration of the vaulting and ribbing, though again the object of much witless speculation (Moorish cupolas, etc.). It can be demonstrated that Guarini shared this mathematical understanding with Nicolas-François de Blondel, but in each case, their successors failed to maintain an awareness of this advanced mathematical procedure.⁸ Both upheld mathematics as the premier science governing architecture; they shared the Baroque metaphorical structure of space that brings together the different arts and sciences while coming to terms with the practical life, *decorum* and the *ethos* of traditional culture⁹ – in other words, 'communicative space'.¹⁰ Thus my assessment is contrary to that of Giulio Argan who insisted in a review of a book on Guarini, that 'no-one more than Guarini has affirmed the non-symbolic, non-allegoric, non-metaphorical character of architectural form', a point of view that is fundamentally antithetical of anything meant by the word 'Baroque' and the work of Guarini.

The grammar of elements

The Theatine, an active philosopher and teacher in the manner of Second Scholastic, was a traditional rationalist, where the certitude of mathematics resided, as Aristotle prescribed, in the sidereal world, an issue that runs through his treatment of mathematics in the *Euclides adauctus*. But he was also influenced by contemporary strains of rationalism, hinted at in his appeal to the authority of Petrus Ramus (Ramée) and Francis Bacon. While not mentioned in any text, another authority was Alberti, and his procedure of identifying elements in his treatise on painting:

The first thing to know is that a point is a sign which one might say is not divisible into parts. I call a sign anything that exists on a surface so that it is visible to the eye. No one will deny that things which are not visible do not concern the painter, for he strives to represent only the things that are seen. Points jointed together continuously in a row constitute a line. So for us a line will be a sign whose length can be divided into parts, but it will be so slender in width that it cannot be split. A curved line is one which runs from point to point not along a direct path but making a bend. If many lines are joined closely together like threads in cloth, they

will create a surface. A surface is the outer part of a body which is recognised not by depth but by width and length, and also by its properties. Some of these properties are so much part of the surface that they cannot be removed or parted from it without the surface being changed [Alberti 1972: Book I, 37].

While Euclidian in origin, this is evidence that the analogy of syllables and the grammar of orthography – the foundation of the first Liberal Art of the quadrivium, geometry – was a commonplace in European thinking about visual art, which was a subalternate art of the quadrivium. However, it is nonetheless surprising that we find a similar interpretation of building appearing in the *Architettura civile* in such terms. However there is some further evidence to be considered, that of the treatment of architecture in Claude-François Milliet Dechaies SJ's *Cursus seu mundus mathematicum* [1674], a text known to Guarini. The Savoyard Dechaies (1621-1678) lived mostly in France and, though not a Cartesian, was abreast of the latest physics, so his inclusiveness points the way to later encyclopaedic efforts to come. This mathematician was followed by C.-A. d'Aviler, pupil of Nicolas-François de Blondel, who modelled his two treatments of the Orders on Scamozzi (1685) and Vignola (1699), indicating a pluralism that became widely rampant.

The importance of Dechaies's 'elemental geometrisation' of architecture casts a confirmatory realisation in a work of his great contemporary, Guarini. The instance of trying to invent a basic elemental system of building, through Dechaies's rationalisation of the orders, was in accord with the implicit systematisation of the orders proposed by Serlio and confirmed by Vignola, but not adhered to by Guarini, who could invent a variety of orders, as he did in the *Architettura civile*. Guarini went further to organize his treatise on architecture by modelling all five parts on levels of ancient geometrical order, and based where possible on harmonic proportions. As to Claude Perrault, his new system of proportions was not ancient but Cartesian, as placing the architect in charge of nature, and able to dispense with harmonics in favour of authority – the French crown, and custom, which is not clearly defined [McEwen 1998: 325]. Guarini was consistent in applying his learning of Universal Mathematics, mostly to do with harmonics, to his complete presentation of architecture in his overall treatise, and not just the Orders.

Conclusion

It is evident that few great figures of our culture have endured such misrepresentation for so long as has Guarini, some of which I have indicated above. It is to be hoped that this investigation of Guarini's mathematics in the context of the culture of the Baroque will lead to a surer confirmation of his greatness and his intellectual superiority in that 'century of genius', and to place him alongside the great figures of European architecture not because he was like them, but because he understood what he meant to a degree that surpassed them all. Beyond that achievement, Guarini was a thinker who worked hard to explain light, and to support the advance of mathematics through summation to infinity by harmonic proportion, an overall project soon to be solved with the discovery of calculus by the end of the century. With his command of both sacred and secular hermeneutics, Guarini was successful in combining both in repeated ways in this work and architecture.

Finally, no one has attempted to account for the failure of Guarini and his immediate successors to publish the complete treatise on architecture during his lifetime or after his death. The artistic climate in European courts was changing just as Guarini commenced

his sojourn in Turin. Through the principal agency of Poussin and the Fréart brothers across Europe, there was a campaign to reject the *licence* of such figures as Borromini and Bernini, measured in the alleged 'conversion' of the aged sculptor eventually to their form of artistic rectitude in Rome and also in Paris. This acerbic classicism which successfully alleged that Borromini was a Goth, may in due course have won out at the court of Turin, due to the supreme variety of Guarini's Orders, including the Salomonic and even 'undulating architecture' not to mention a column version of the hated Gothic, all of which figure so prominently in the plates to the *Architettura civile*. Could these have now caused offence, after the completion of the Royal Chapel of the Holy Shroud? Could these plentiful licenses in Guarini's treatise have been too much for any prospective high-ranking patron to support in a changing intellectual climate, caught between Rome and Paris? Thus it was left to another generation, when the promising and well-connected young architect Bernardo Antonio Vittone was successful in bringing the full work on architecture to the light of day in 1737, with the prominent support of the Provost General of the Theatines in Rome who supplied the preface. In Vittone's hands the magic of the Baroque had its Indian summer in Piedmontese towns where he built so many parish churches, but with his death, the vigour and vision of the Baroque was seen no more south or even north of the Alps. Neoclassicism had won, with the secularisation of all artistic forms to follow.

Notes

1. *Conclusio: nam omnes artes vel a Mathematica, vel a Philosophis, vel a medicina dependent; quae omnes scientiae vel rerum similitudinem, vel proportionem, vel convenientiam considerant* [Guarini 1665, 214].
2. Pérez-Gómez has pointed out that the treatise is modelled on that of Carlo Cesare Osio, a Milanese architect, with the same title, published in 1684, and he indicates that this was a model for Guarini's deliberations. However by the time of Osio's publication Guarini had died, and I suspect that they knew each other, Guarini actually dying in Milan, where Osio might have been his assistant in his last days. Therefore the proportional doctrine of Osio may be from Guarini, so he did not need to quote ancient sources, as Pérez-Gómez suggests he should, and which was uncommon in many mathematical texts anyway.
3. In his paper 'Guarini the Man' [1975], Rudolf Wittkower did not examine the deeper mathematical meaning of the *Architettura civile*.
4. [Guarini 1968: Tr. II, Cap VIII, *Del Modo di disporre un colonnato nel tondo*]. Guarini opposed the Benedictine's consistent corrections of the apparent sizes of elements viewed from a distance, which indicates that the spectator is not immobilised, for Guarini.
5. [Guarini 1968: 277]. Guarini was certainly very conscious of Gothic achievements, and the Chapel of the Holy Shroud, with its iron reinforcement as evidence of techniques arising in Paris at that time.
6. Guarini was surely describing the culture of Italian and French architects in his day, which no one has yet indicated, cf. [Guarini 1968: Tr. I, Cap. III]: *quando però si tratta, che le sue dimostrazioni osservare siano per offendere la vista, la cagione, la lascia, ed infine contradice alle medesime* (...so that, if the eye should be offended by the adherence to mathematical rules – change them, abandon them, and even contradict them). Presumably the background notion is to invent new rules.
7. As stated by one of his students, Saint Vincent was 'one of the great pioneers in infinitesimal analysis'. J. E. Hofmann, 'Saint Vincent, Gregorius', in voce, [Gillispie 1970-1981]. His main work was *Opus geometricum quadraturae circuli et sectionum conii*, 1647.
8. I will explore this connection in my forthcoming paper, 'The Mathematics of Nicolas-François Blondel and the Four Problems of Architecture'.
9. 'The unity of Baroque space . . . is established by the metaphorical structure of space, which has the capacity to hold together different arts and at the same time meet all the most important conditions of practical life: *decorum* and *ethos*' [Vesely 1987: 33].

10. [Vesely 1994: 81]. The author explains the concept of communicative space with reference to the Baroque library on pp. 80-81.

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About the author

James McQuillan was brought up in Ireland where he was trained as an architect at University College Dublin, graduating in 1969. He proceeded to study the M.A. in the History and Theory at the University of Essex where he was taught by Profs. Joseph Rykwert, Dalibor Vesely and George Baird, where Daniel Libeskind was one of his fellow-students. Returning to Ireland, he was engaged in professional practice and part-time teaching in his old school of architecture, as well as spending a year in Rome as a *borsista* of the Italian Government. Elected a member of the RIBA, from 1978 to 1982 McQuillan ran his own practice in Northern Ireland, and then he went to teach in Saudi Arabia, in Dammam. In 1986 he arrived at the University of Cambridge where Dalibor Vesely supervised him in his thesis on Guarino Guarini, and he has since been teaching and researching in architecture worldwide, with contributions to the international conference circuit. His book, *Modern Architecture as Landscape*, is being completed and he teaches part-time at Lincoln and Nottingham Trent Universities.