



## **“Ars sine scientia” or rather “Ars sine geometria”? The debate of 1400 on the elevation of Milan cathedral**

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### **Abstract**

The construction of Milan Cathedral from 1386 was one of the most important episodes in the history of Italian and European architecture because of the uniqueness of the building itself — the largest Gothic church ever constructed in Italy — and because of the presence of some of the most authoritative architects of the late Fourteenth and Fifteenth centuries in Europe (Lombard, French, German).

The documentation about the discussions on how to build the Duomo in the late Trecento and early Quattrocento, especially on the structural choices to be made and the different Lombard and Northern building-site practices, made famous to English readers in a celebrated article by James Ackerman, is extraordinarily rich and extensive, permitting considerations on the relationship between medieval architectural ideals and an actual project.

The paper focuses on the famous discussions of 1400, in part a re-run of those of 1392. It will be argued that famous criticism by the French expert Jean Mignot of Milanese architects involving the terms *ars* and *scientia* could have a very different meaning from the one generally accepted in the literature. Consequently, it will result that Mignot wanted to return to the original project proposed by Gabriele Stornaloco, which embodied the desired correspondence between the sacred architecture and the perfect God’s world.

All of which, could be of some interest to medievalists in general, and to those concerned with architectural theory and with the relationship between Gothic architecture and literature in particular.

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### **Keywords**

*Architectural theory; Building knowledge; Geometry; Gothic architecture; Milan Cathedral.*

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### **1. Introduction**

The construction of Milan Cathedral from 1386 was one of the most important episodes in the history of Italian and European architecture, at least because is the largest Gothic church ever constructed in Italy, and because of the presence of some of the most authoritative architects of the late 14th and 15th centuries in Europe (Lombard, French, German).

The documentation about the discussions on how to build the Duomo in the late Trecento and early Quattrocento, especially on the structural choices to be made and the different Lombard and Northern building-site practices, made famous to English readers in a celebrated article by James Ackerman, is extraordinarily rich and extensive, permitting considerations on the relationship between medieval architectural ideals and an actual project (Fig. 1).

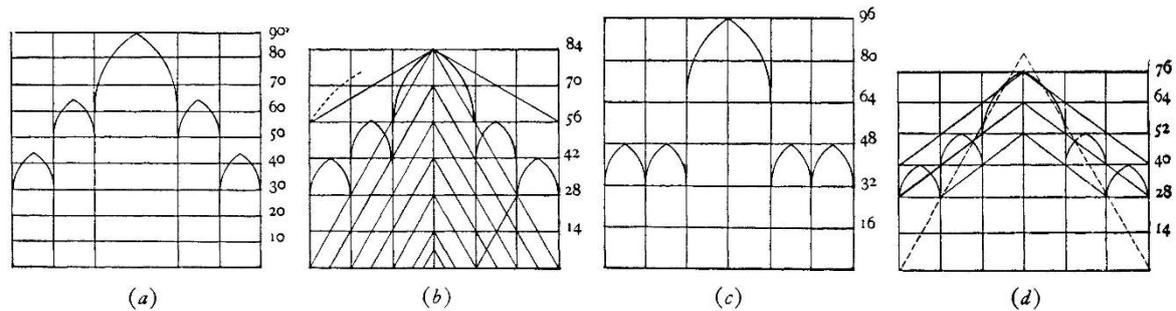


Figure 1. Giacomo Brogi, Milano. La cattedrale, 1870 ca. Catalogue no. 3818 (public domain)

A brief history of this celebrated article is a useful starting point. James Ackerman landed in Italy for the first time in 1942 as a soldier of the US Army, just after having graduated in History of Art at Yale University in 1941. Going up the Peninsula from Sicily until Milan, he asked to be transferred to the office dealing with the recovery of the works of art, and he was assigned to the recovery of the Milanese royal archive, transferred during the war in Certosa di Pavia. He was in a sense one of the Monuments Men, become famous with the movie by George Clooney. It was thanks to these constant visits — until 1945 — to the chartreuse and the contact with those secular papers that he decided to become an architectural historian and that church became the subject of his dissertation at New York University once returned home. It was also certainly the occasion for familiarizing with the records of Milan Cathedral published as the *Annali della fabbrica del Duomo di Milano dall'origine fino al presente pubblicati a cura della sua amministrazione* from 1877 and 1885 in nine volumes, some of which constituted the basis for his celebrated article of 1949 “‘Ars sine scientia nihil est’: Gothic Theory of Architecture at the Cathedral of Milan”. The short quotation in the title comes from the minute of a meeting of Cathedral’s administration and architects, held on 25 January 1400 (Nava, 1854: 94-6; *Annali*, I: 209-10), and over the years has assumed an almost proverbial character.

Investigating “the problem of Gothic theory and practice” (Ackerman, 1949: 85), he found that the transcriptions of the meetings of 11 and 25 January 1400 (*Annali*, I: 208-10) were the ones in which “questions of theory play a major role” (Ackerman, 1949: 96, 98), showing — according to him — how much the Milanese architects were “quite as deficient in practice as they are in theory” compared to the foreign, Northern ones (Ackerman, 1949: 96, 98). In his view, “the history of the Cathedral is one of constant wrangling between local and foreign builders” (Ackerman, 1949: 87), with the Milanese “not moved by any conception of rational, causative relation among plan, section, and elevation” (Ackerman, 1949: 94).

His interpretation of the incompetent Lombard master-builders compared to the theoretically prepared Northern architects — essentially based on these two minutes —, which would have lead to several different solutions — up to four — for the elevation of the Cathedral during construction, has been followed in the literature on Milan Cathedral and more in general on Gothic architectural theory until now (Fig. 2).



MILAN, CATHEDRAL. PROJECTS FOR DETERMINING HEIGHT OF NAVE, AISLES, PIERS, AND VAULTS TO BE ERECTED ON FOUNDATIONS 90 BRACCIA WIDE. (a) Project of 1390 employing units of 10 braccia, after sketch and notes by Antonio di Vicenzo. (b) Project of 1391 employing units of 14 braccia, within framework of equilateral triangles, after sketch by Gabriele Stornaloco. (c) Project of 1392 employing grid of squares, reconstructed from texts. Probably proposed by Heinrich Parler of Gmünd. (d) Project accepted in 1392 employing Stornaloco's project to a height of 28 braccia (dotted lines), and continuing with units of 12 braccia within framework of Pythagorean triangles, after specifications of Cathedral council.

Figure 2. (Ackerman, 1949).

The Milanese architects were, according to Ackerman, bogged down by continuous changes of architects, constant indecision and constructional mistakes due to their provincialism and lamentable theoretical and technical knowledge, which resulted, in fact, in the building proceeding "haphazardly, without an ultimate aim". The author also speaks of the "provincial character" of Lombard architecture, of architects who are "poorly prepared"; that there was "little evidence of technical growth"; of the fact that the "French and German masters who were hired to aid the architects of Milan Cathedral were bitterly received and poorly treated"; of the "inadequacy of the provincial tradition"; of the "difficulties encountered by the Milanese"; of their "great uncertainty", of "difficulties in forming a definitive and consistent program", of the "illogical order in which the problems are submitted", of the "capricious shift in mid-air" for the alleged change to the system of Pythagorean triangles proposed by Luca Beltrami, and so on (Ackerman, 1949: 85-89, 92-93).

But, following Marvin Trachtenberg, "one wonders whether traditional historical criticism is correct when suggesting, in effect, that building procedures in the period often resembled the Dadaist game — as in, for example, James Ackerman's celebrated analysis of the planning of Milan Cathedral" (Trachtenberg, 2010: 67). Trachtenberg also interestingly point out that Ackerman's article has to be considered in the context of the "Modernist" historiography of the 20th century (Trachtenberg, 2010: 240-243, 266). The article certainly resonated of the contemporary cultural debate, so much that the young architectural historian was invited to participate in the famous conference *De Divina Proportione. Primo Convegno Internazionale sulle Proporzioni nelle Arti*, organized by Rudolf Wittkower and held in Milan on 27-29 September 1951, with a paper on the same subject entitled "Le proporzioni architettoniche gotiche. Milano, 1400" (Cimoli, 2007).

Ackerman's interpretation of the word *scientia* as theory, in the sense of "the higher learning in architecture", "abstract mathematical theory", "higher geometrical principles", "theory of consistent relationships", and "ideal formulae" (Ackerman, 1949: 100, 101, 105, 107), is very questionable when one carefully re-reads the texts and analyses them the context in which they were created, also in the light of the actual building organization and practices of the time. The meaning of the terms *ars* and *scientia* in these discussions can be accordingly revised, with substantial consequences for the reconstruction of the history of Milan Cathedral.

Let start with the context in which the two minutes were produced. The minutes of the meetings of 11 and 25 January 1400 called by the *Deputati* — the administrative board for the construction of the Cathedral —, in which the criticisms to the work done until then by the Lombard architects expressed by the French expert Jean Mignot — which actually arrived at Milan Cathedral just as an assistant of other two experts on 13 April 1399 (Nava, 1854: 79-81; *Annali*, I: 194, 197) —, were drawn up by notaries in Latin (Nava, 1854: 83; *Annali*, I: 202). So, probably most of the architects, who spoken also different languages, could not understand it, as well as the notaries could have misunderstood some technical aspects. This is an important point to consider particularly where the written reports may seem obscure. Already Ambrogio Nava in 1854 acutely signaled this aspect, saying that "le censure presentate in iscritto dal Mignoto, con le risposte giustificative de' nostri ingegneri, vennero registrate in forma notarile [...], si

incontreranno parole e frasi oggidì fatte inintelligibili, sia per la barbarie del latino, in cui furono dettati, sia per l' incuria degli amanuensi che li trascrissero, sia per i processi ora perduti dell' arte edificatoria, sia finalmente, nel caso attuale, per simultaneo concorso di architetti e di operaj, diversi per nazione o per lingua, i quali portando ognuno nella discussione il proprio contingente, hanno dato luogo ad un mosaico di parole" (Nava, 1854: 86).

The texts, however, are organized in a clear sequence of objections and replies, so that the respective points of view of Mignot and the Milanese architects are clearly distinguishable.

Regarding the content of these records, of the 54 objections raised by Mignot in the first meeting, 21 of them were concerning structural problems, about the same number small dimensional differences, with few other questions about ornamentation and architectural composition; many of them were evidently recurring and tendentious, so much that the Lombards did not answer to 29 of them (Annali, I: 208). In the second meeting Mignot added further criticisms, focusing, as in the first case, mostly on questions about stability and strength (*fortitudo*), and is in the minute of this meeting that the term *scientia* appears. The crucial passages are in the objections nos. 2 and 3:

2. Item dicit [Mignot] quod quatuor turres sunt incoeptae pro sustinendo tiburium dictae ecclesiae et non adsunt piloni nec aliud fundamentum habiles pro sustinendo dictas turres, imo si ecclesia esset facta in toto illico cum dictis turribus infalibiliter rueret, super iis vero quod certe per passiones factae sunt per aliquos ygnorantes allegantes quod voltae acutae sunt plus fortes et cum minori onere quam voltae retondae, et plus super aliis propositum est ad voluntatem quam per viam virtutis; et quod est deterius oppositum est [by the Lombard masters] quod scientia geometriae non debet in iis locum habere eo quia scientia est unum et ars est aliud. Dicit magister Johannes dicit quod ars sine scientia nihil est, et quod sive voltae sint acutae sive retondae non habendo fundamentum bonum nihil sunt, et nihilominus quamvis sint acutae habent maximum onus et pondus.

Item dicunt [the Lombard masters] quod turres quos dixerunt sibi velle facere dicunt pluribus rationibus et causis, videlicet, primo pro retificando praedictam ecclesiam et croxeriam quod respondent ad quadrangulum secundum ordinem geometriae; alia vero pro fortitudine et pulchritudine tiburii, videlicet quasi per istum exemplum in paradiso Dominus Deus sedet in medio troni, circha tronum sunt quatuor evangelistae secundum Apocalissim, et istae sunt rationes quare sunt incoeptae. Et quamvis non sint fundati duo piloni pro qualibet sacrestia incipiendo super terram, ecclesia est tamen fortis bene istis rationibus, quia repressae super quibus dicti duo piloni et praedictae repressae sunt de magnis lapidibus et inclavatis cum clavibus ferri sicut dictum est supra cum aliis capitulis, et quod pondus dictis tribus [sic: "quatribus"] turribus ponderat [sic] ubique super suum quadrum, et erunt aedificatae recte et fortiter, sed [sic: "et"] rectum non potest cadere; unde dicunt quod sunt fortes per se et ergo dabunt fortitudinem tiburio, quia clausus est in medio illarum turrium unde dicta ecclesia bene fortis est.

3. Item cognoscit [Mignot] quod voluntarie agitur in praemissis nec contradicentes volunt condescendere juri et meliori dictae ecclesiae et fabricae, sed volunt aut per eorum lucrum aut timorem, quia voluerunt consequi fabricam super defectibus, aut obstinatione vincere causam, et pro tanto petit dictus magister Johannes committi debere IV vel VI vel XII ex melioribus inzigneris expertis in talibus, sive de Alamania, sive de Anglia, sive de Franzia, cum aliter dicta fabrica ruet pro certo, quod erit magnum damnum universimodo. Ulterius pro veritate evidenti et sui honoris conservatione accedere vult ad presentiam illustrissimi domini Domini et eidem praedicta et alia latius explicare. Item significat quod pro bono ecclesiae foret bonum alibi laborare in dicta ecclesia quam super locis defectuosis saltem usquequo fuerit clare provisum et decisum super istis defectibus.

Item dicunt et respondent [the Lombard masters] in eodem capitulo quod ubi dicit [sic] quod scientia geometrica non debet in iis locum habere, dicunt suprascripti quod si hoc testante videlicet per regulam geometriae Aristotulus dixit hominis autem motus secundum locum quem vocamus lationem, aut reclusus aut circularis aut ex eis mixtus. Item idem dixit [Aristotle] alibi omne corpus perfectum est in tribus et motus ipsius et dictae ecclesiae ascendit ad triangulum ut jam declaratum fuit per alios inzignerios, unde dicunt quod omnia sunt per rectam lineam, aut per sextum: ergo concluditur quod quae facta sunt, sunt facta per geometriam et per praticam, quia ipse dixit [Aristotle, not Mignot] quod scientia sine arte nihil est; de arte autem jam responsum est in aliis capitulis" (Annali, I: 209-10; italics mine).

As already mentioned, the word *scientia*, has been intended by scholars as theory, in opposition to practice (*ars*), but in the whole report the term is clearly used only to refer to geometry: we find the expression “*scientia geometriae*” immediately followed by the terms “*scientia*”, “*scientia geometrica*” and then again “*scientia*” alone, and we should also note the apposition of the terms “*geometria*” and “*practica*” (as synonymous of *ars*).

Thus, at point no. 2, Mignot actually asserted that the four piers that will support the *tiburio* (the dome over the crossing) are not strong enough and will certainly collapse; that the Lombards are ignorant (“*ygnorantes*”) when claiming that pointed arches are stronger than semi-circular arches (which indeed is true in terms of horizontal thrusts); and — worse still — that geometry (“*scientia geometriae*”) has no importance in this context since geometry (“*scientia*”) is one thing, and practical knowledge (“*ars*”) another. He then argues that practical knowledge (“*ars*”) without geometry (“*scientia*”) is worthless; that vaults, whether pointed or semi-circular, are useless without good foundations; and that, in any case, pointed vaults weigh more.

The Lombards then replied stating that the four piers are built on a square plan according to the principles of geometry (“*geometria*”); that it is untrue that the sacristies partially supported them; and that they were soundly built of big blocks of stone tightly bound together with iron dowels, as they had already explained. They then add that the weight of those piers — “three” is clearly a mistake of the transcriptionist for “four” — will be discharged equally onto the square perimeter (of the plan of the crossing) and they will be built vertically and strong, but — another mistake of the transcriptionist for “and” — that which is vertical cannot collapse, that means that there will be no eccentric thrusts outside the square formed by the four supports and the weight of the four piers of the crossing and of the *tiburio* above will discharge itself vertically so as to give the *tiburio* appropriate support.

At point no. 3, Mignot insisted that the building would certainly collapse and that it was his duty to point out the defects.

Answering to this point, the Lombards made use of Aristotle — very inaccurately we have to admit — and argued that the church had been constructed *ad triangulum* (i.e. according to the figure of an equilateral triangle), as had been previously established by other engineers, and that it had been designed, therefore, with ruler and a pair of compasses (“*per rectam lineam, aut per sextum*”), i.e. with the use of straight lines and segments of circles. They concluded that what had been built had indeed been executed with both geometry (“*geometria*”) and practical knowledge (“*practica*”), adding that Aristotle, and not Mignot, as Ackerman and subsequent scholars have interpreted (Ackerman, 1949: 101), had said that geometry (“*scientia*”) is nothing without practical knowledge (“*ars*”). It is in this context, therefore, that the Lombards stated that the science of geometry, referring to the use of perfect, regular figures such as the circle, is not relevant to such discussions since geometry is one thing and practice another, and that the pure geometrical skeleton needed practical adjustments to be built: “*scientia [geometriae] sine arte nihil est*”.

In conclusion, reading these two documents in their entirety, it became clear that they were mostly concerned with structural problems about the stability and strength of the four piers, which would have supported the *tiburio*, and not with questions of theory as claimed by Ackerman (Ackerman, 1949: 96, 98). The Lombard engineers correctly replied to Mignot’s criticisms in terms of building practice, for instance when, in the meeting of 11 January 1400, they declared that “*archi spiguti non dant impulsam contrafortibus*” (Nava, 1854: 87; *Annali*, I: 203), they were evidently referring to the fact that pointed arches produced less horizontal thrust than semi-circular ones, which is actually true; when, in the same meeting, they were explaining the construction-methods for foundations and piers using metals dowels (Nava, 1854: 94-96; *Annali*, I: 202-205); or when, in the meeting of 25 January 1400, Mignot at point no. 1 repeated that the piers should have been three times thicker, they replied as before that they were strong enough, because the marble used at Milan Cathedral was much more resistant than the Parisian sandstone (Nava, 1854: 94-96; *Annali*, I: 202-205, 209-210).

More in general, the questions defined by Ackerman as “theoretical”, or which suggest an opposition between the theory and practice of two opposed schools of thought, one advanced and scientific versus one provincial and empirical, can be rather intended as merely part of the same pre-scientific cultural baggage of the period, when statics hardly existed as sciences and practical geometry ruled in the building culture. Construction was validated by geometry, using elementary procedures, which guaranteed certain stability, coupled with knowledge of local building techniques and materials.

Finally, we have tried to demonstrate elsewhere (Schofield, Ceriani Sebregondi, 2015; Ceriani Sebregondi, Schofield, 2016) that a first project ad quadratum (i.e. according to the figure of a square) never existed and that the project by Gabriele Stornaloco of 1391 was never abandoned in favor of one with Pythagorean triangles as proposed by Beltrami (Beltrami, [1887] 1964), but was just slightly modified for constructive reasons. Thus, the idea proposed by Ackerman of continuous changing of project — up to 4 (Fig. 2) — and of constant indecision and disorganization, implying a construction advancing even “haphazardly” (Ackerman, 1949: 85), falls.

The main reason of contrast between Jean Mignot and the Lombard architects, in the end, consisted in the fact that Mignot wanted to return to Stornaloco’s original project, which embodied the desired correspondence between the sacred architecture and the perfect God’s world, while the latter were pursuing the modified version of it, already adopted in 1392. This is why, claiming for a return to Stornaloco’s perfectly geometrical scheme, in contrast to the adapted version of the Lombards, Mignot considered the Lombards knowledge of geometry defective (“ars sine scientia [geometriae] nihil est”), accusation to which they replied that the pure geometrical skeleton needed practical adjustments to be built (“scientia [geometriae] sine arte nihil est”).

## References

- Ackerman, J. S. (1949). "Ars Sine Scientia Nihil Est" Gothic Theory of Architecture at the Cathedral of Milan. *The Art Bulletin*, 31(2), 84-111 (reprinted in Ackerman, J. S. (1994). *Distance points: Essays in theory and renaissance art and architecture*. Cambridge, MA: The MIT Press, 211-68)
- Annali della Fabbrica del Duomo di Milano dall’origine fino al presente. (1877). Milano: G. Brigola, vol. I
- Beltrami L. (1887). *Per la facciata del Duomo di Milano*. Beltrami, L., & Ramelli, A. C. (1964). *Luca Beltrami e il Duomo di Milano: Tutti gli scritti riguardanti la cattedrale pubblicati tra il 1881 e il 1914*. Milano: Ceschina, 37-91
- Ceriani Sebregondi, G., & Schofield, R. (2016). First Principles: Gabriele Stornaloco and Milan Cathedral. *Architectural History*, 59, 63-122.
- Cimoli, A. C., & Irace, F. (2007). *La divina proporzione: Triennale 1951*. Milano: Electa.
- Nava, A. (1854). *Memorie e documenti storici intorno all’origine, alle vicende ed ai riti del Duomo di Milano*. Milano: Tipografia Borroni et Scotti.
- Schofield R, & Ceriani Sebregondi G. (2015). *Disegni di Antonio di Vincenzo per il Duomo di Milano*. Repishti F. *CORPUS DEI DISEGNI DI ARCHITETTURA DUOMO DI MILANO*. [www.disegniduomomilano.it](http://www.disegniduomomilano.it). Milano: Politecnico di Milano.
- Trachtenberg, M. (2010). *Building-in-time: From Giotto to Alberti and modern oblivion*. New Haven, CT: Yale University Press.