



Vitruvius and the Education of the Architect

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Introduction

From Daedalus to Vitruvius, it took time to turn architecture into a profession. The position of the architect rose during the Roman Empire, as architecture became a particularly important symbolic statement (Diane 1996).

The aim of this research was to draw a portrait of the architect in the first century before common era (BCE) in Rome described in *De Architectura* (DA), the famous treatise on architecture written by Vitruvius. Then, this approach was shaped to discover the principles of education of the architect from Vitruvius's point of view. He provided some interesting information in his book; however, some of the definitions are often misunderstood.

The Greeks had no word for *architecture*, or even art (Kristeller 1965, p. 166). They had *technē*, which was a larger realm of knowledge and intervention. The etymology of *technē* indicates an analogy with birth: the root *tec-* refers to the act of making something appear (Roochnik 1996, p. 19), and *technē*, in its pre-Homeric meaning, came to refer to the knowledge or skill of *tekton*. The realm of *technē* included subjects that our modern era would categorize as science, crafts, and arts. It could mean in a physical object (a house or a painting), a performance (a song or a dance), or an altered condition (health in humans or training in horses) (Pollitt 1974).

The original Greek word *architekton*, translated as architect, means chief builder. It was assembled from two units, each with its own meaning: *archi-* as chief and *tekton* as builder or woodworker (Briggs 1927, p. 3). Some scholars have regarded the *architekton* simply as a master craftsman with no real responsibility for the design of buildings (Bundgaard 1957, p. 139). In the same passage, however, Plato accepted that the architect is not himself a workman but a director of workmen, and that he contributes theoretical knowledge and not practical craftsmanship (Plato 1997, 260b; Briggs 1927, pp. 12–14). Translating the word *architekton* from Greek to Latin is not an easy translation. The Latin word *architectus* appeared around 200 BCE and had two different meanings: master builder and inventor (Briggs 1927). The first meaning retained the Greek etymology, but the second did not (Anderson 1997, pp. 3–8; Parcell 2012). In Vitruvius's treatise, the earlier role of the *architekton* (a chief builder who directs builders) is superseded by a different role that is more diverse and less concrete but still inhabits the shell of the Greek word (Pont 2005; Parcell 2012; Rawson 1985, pp. 86–87).

The Liberal Arts

The concept of the liberal arts (*artes liberales*) as a basis for professional training was based on the Greek Hellenistic type of education, which meant general or usual education (Rawson 1985, p. 117). In the Roman world, the liberal arts were understood as arts that a free man should know so that he could participate intelligently in the public realm (Lewis 1879; Parcell 2012). They were divided into two different syllabi: *trivium* and *quadrivium* (Rawson 1985, p. 117; Brown 1963, p. 100). The former, including three basic arts—grammar, rhetoric, and dialectic—was taught in elementary school. The latter, consisting of the mathematical arts (i.e., arithmetic, geometry, astronomy, music), belonged to the program of the school teaching oratorical arts and philosophy (Rawson 1985, pp. 117–118; Brown 1963, pp. 101–103; Marrou 1956).

The idea of architecture becoming a part of the liberal arts was first propounded by Cicero. According to him, “as suitable for free men, architecture is the first we have met to introduce us to a few men from something like an Italian professional class” (Rawson 1985, p. 86). For Cicero, the word architecture is more abstract and it does not refer to a particular thing (Parcell 2012, p. 25). Varro (1982), a contemporary of Cicero, included medicine and architecture as his eighth and ninth liberal arts in his book, which is now lost (Rawson 1985, pp. 186–187). He was the only philosopher to identify architecture explicitly as a liberal art and wrote a book about it (Rawson 1985, p. 191). Vitruvius's own ideas on liberal arts as the basis of the education of the architect are not just an ideal, and they are not his own invention because his education, designed by his parents, clearly embodies them (Vitruvius 1960, p. 168). Vitruvius's education, however, almost certainly does not represent the way all Roman architects were trained (Vitruvius 1999, p. 7). He did not refer to architecture as a liberal art; however, some have thought that his recommendation to study liberal arts before studying architecture implied that architecture is a part of the set (Brown 1963; Parcell 2012; Krufft 1994).

Education of the Architect

Who were the architects and engineers, and how did they acquire their knowledge? The only surviving discussion of what the architect and engineer needed to know is that of Vitruvius, who makes this point even more clearly and at far greater length. Idealistic and unrealistic though his views may seem, they are worth considering, because they came directly from his own experience as an architect and military engineer (Vitruvius 1960, pp. 5–8).

Considering his description that architecture is a branch of science that relates to both liberal and mathematical arts, essentially it is a building science, in which the design and construction aspects both must have a rationale. In the opening sentences of the DA, he wrote: “the architect should be equipped with knowledge of many branches of study and varied kinds of learning” (Vitruvius 1960, p. 5). In the following passage, Vitruvius built up a detailed profile of the professional architect. The one who relies on practical experience, or *fabrica*, without attending to the intellectual side of architecture, or *rationatio*, is not worthy of the name of architect (Vitruvius 1960, p. 5).

Vitruvius's architect deals with both practical experience and theoretical knowledge. *Fabrica*, Vitruvius insisted, is a question of repeated manual activity, a habit acquired from long experience: "Practice is the continuous and regular exercise of employment where manual work is done with any necessary material according to the design of a drawing" (Vitruvius 1960, p. 5). *Fabrica* is also a kind of *technē* derived from thoughtful study of the various constructive crafts, and it is the practice of architectural contemplation. In other words, Vitruvius "relates *fabrica* to the hands and to the meditative making of the craftsman who gives form to materials. Like Aristotle, he recognizes that the hands are both inherently talented (or not) and trained by regular employment: the hands are the tool which makes tools" (Pérez-Gómez 2006, p. 148). However, *ratiocinatio*, Vitruvius wrote, "is the ability to demonstrate and explain the productions of dexterity on the principles of proportion" (Vitruvius 1960, p. 5).

The Roman term *ratio* and all its derivatives go back to the Greek term *logos* (Lewis 1879). The realm of *logos* included many subjects. It can mean simply word; it can mean the underlying point that makes sense or meaning behind everything else; and it can mean language, logic (method of reasoning), theory, principle, reason, *ratio* (in the mathematical sense), and rational thinking (Morgan 2004, pp. 30–37). *Ratiocinatio*, like *logos*, has connotations of exact knowledge and theory, so Vitruvius's *ratiocinatio* could be understood as mathematical knowledge and speculative theory (Pont 2005, pp. 76–85; Granger 1925, pp. 67–69). From this view, architecture is scientific building, that species of design and construction distinguished by having a *logos* or rationale. For the Pythagorean Plato, that rationale was the harmonic proportions of the world system or the musical system (Lippman 1964, pp. 1–44; McClain 1978, pp. 2–10; Vitruvius 1960, pp. 8–10; Walden 2014, pp. 125–128).

Vitruvius laid out nine areas of learning that he thought were essential for the architect: writing (*litteras*), drawing (*graphidis*), geometry (*geometria*), history (*historias*), philosophy (*philosophia*), music (*musicen*), medicine (*medicinae*), astronomy (*astrorum*), and law (*iura*). However, he did not believe that the architect should be master of all those branches of study.

Writing

The first requirement Vitruvius sets for the architect is that he needs to have a literary education, because writing is the basis for all reasonable discussion and constitutes the field in which the *DA* is to operate (Carpo 2001, pp. 18–20). Vitruvius wrote: "An architect should know writing (*litteras*) so that he can produce a stronger memory in commentaries (*commentariis*)" (McEwen 2003, p. 17; Vitruvius 1960, p. 6).

In the Greek building inscriptions, we can find the architect drawing up a specification and giving instruction to the builder but not engaged in building (Bundgaard 1957). It is clear that Greek architecture in its construction, proportions, and details varies little from one building to another, so the architect could characterize his building fully in description. When the types are few and the structure is simple, there is no need to draw the building to grasp it himself. This kind of description is called the *syngraphai* (συγγραφή) in Greek (Bundgaard 1957, p. 97). Clearly, its meaning is writing or noting down (Liddell and Scott 1996). There is no reference to drawings, ground plans, or elevations in *syngraphai* (Bundgaard 1957, pp. 97–98). Along with the inscriptions on the buildings are specifications, contracts, and accounts that deal with the construction of the building rather than its conception. As a result, in Greek architecture, writing came first, which explained ideas better than drawings, which was something Vitruvius discussed.

Vitruvius pointed out that the architect had to read *commentarii* to train his memory. He seemed to understand *commentarii* as a kind of writing normally used by architects (McEwen 2003, p. 18). Vitruvius also referred both to his own writings and to his architectural sources as *commentarii* (McEwen 2003, p. 18; Vitruvius 1960, pp. 6, 101, 199). Daniele Barbaro (1514–1570), who was an Italian translator of and commentator on Vitruvius's book, believed that the word *commentario* actually connoted putting things together (Italian *commettere*) in the mind in a brief and suitable form (Cellauro 1996). According to him, the architect needed judgment, which is prudent when comparing the plans that he has in his mind with those that have been carried out. By comparing, the architect can weigh his ideas. Because such ideas in the mind are located in the faculty of memory, it is necessary that the memory of the architect is good and firm. To train the memory, the architect has to read *commentarii* and brief comments and be able to recall them. This is, Barbaro concluded, the important function of literacy in the practice and education of the architect (Cellauro 1996; Kanerva 2006; Coulton 1977). It seems that the architect should be literate—a person who is able not only to read and write but also to build up an interesting train of thought. Vitruvius's contemporary Livy called *litterae* "the only faithful guardian of the memory of achievements" (McEwen 2003, p. 17), and according to Vitruvius, being a writing architect could help strengthen memory.

Drawing

Another discipline is drawing (*graphidis*). The architect must have knowledge of drawing, Vitruvius mentioned, "so that he can readily make sketches to show the appearance of the work which he proposes" (Vitruvius 1960, p. 6). It seems that drawing is important to Vitruvius because it immediately comes after writing and before geometry. The number of times he cites drawing, including the opening line of the *DA*, shows that he expects the patrons to be familiar with it. Moreover, there is evidence that Roman architects drew plans of their buildings on parchment (Briggs 1927; Ricci 1928) and that models were frequently used (McIntosh 2013; Briggs 1927). For Vitruvius, drawing is practical knowledge, and the concept of it becomes dependent on geometry. Likewise, in Vitruvius's view, architectural drawing is divided into three parts: *ichnographia*, *orthographia*, and *scaenographia*, translated as ground plan, elevation, and shadow painting or shadow drawing, respectively (Pollitt 1974, p. 251; Plummer 1973, pp. 40–41). Vitruvius claimed

Arrangement [Dispositio] includes the putting of things in their proper places and the elegance of effect which is due to adjustments appropriate to the character of the work. Its forms of expression in Greek *ἰδέαι* [ideae], are these: ground plan, elevation, and perspective. ... All three come of reflection [reflexion] and invention. Reflection is careful and laborious thought, and watchful attention directed to the agreeable effect of one's plan. Invention, on the other hand, is the solving of intricate problems and the discovery of new principles by means of brilliancy and versatility. These are the departments belonging under Arrangement (Vitruvius 1960, pp. 13–14).

The key point in this passage is *dispositio*, which is called the *ideae* [ἰδέαι] in Greek. Both Morgan (1906) and Granger (1925) translated it as "arrangement" (Vitruvius 1960; 1983). The word "arrangement" in English can be defined in two ways: "the act or process of arranging things" or "the position of things in relation to each other in the completed work" (Oxford English Dictionary 1989; Scranton 1974, pp. 495–496). In the short definition of the term *dispositio*, Vitruvius "uses as synonyms the words *conlocatio*

and *effectus*. Of these it will be observed that like *dispositio* itself *conlocatio*—and almost all Latin nouns in—*tio tionis*—have as their primary meaning the sense of the performing of a process, and only as a secondary meaning the result of the process” (Scranton 1974, pp. 495–496). In view of this, *dispositio* is “the process of designing something, as distinguished from the completed design. That is, the making of plans and drawing, not the plan, elevation and spatial form of the building itself” (Scranton 1974, p. 496). Moreover, Aulus Gellius describes “a Roman who intends to build new baths studying plans set out on parchment, and choosing between them” (Clarke 1963, p. 11; Briggs 1927, p. 42). It is clear that dimensioned plans and elevations, as well as shadow drawings, were designed for the patron who could ask the architect to give him the *ideae* of a building (Haselberger 1997).

Vitruvius thought that it might be useful in the practice of the architect to have some knowledge of optics. By optics, he means “the light in buildings can be drawn from fixed quarters of the sky” (Vitruvius 1960, p. 6).

During the Hellenic age, evidence shows that the Greeks were familiar with optical color fusion, the mutual alteration of contiguous colors, and the difference between the additive and the subtractive color systems. The *scaenographia* technique was the artistic expression of that knowledge, and it is not characteristic of perspective but of color systems relying on optical fusion (Keuls 1975, p. 2; Ling 1977, pp. 1–16). In addition, “*scaenographia* in antiquity refer to the application of the laws of optics to art in general, including painting and sculpture as well as architecture” (Pérez-Gómez and Pelletier 2000, p. 101). Daniele Barbaro suggested interpreting *scaenographia* as *sciografia* or *scorzo*, which he translated as “section” (*profilo*), not as “perspective” (Tavernor 2003). He justified the intervention by claiming that perspective is less useful for architects than section. Barbaro explained that perspective is important in theater design and for optical correction because human vision is imperfect. The eye cheats us, making distant objects look close and small objects large; it leads us into errors, which a good architect can correct (Mitrović 1998, pp. 670–671). The idea of optical corrections—as applied to sculpture—was first mentioned and criticized by Plato in the *Sophist* (Pollitt 1974). However, Vitruvius has a number of affirmative passages about optical corrections and many details in the theory of the classical orders (Vitruvius 1960, pp. 80–86).

Geometry

One of the oldest of human endeavors is geometry, and in ancient times it was simply the culture-creating tool with which most things were made, and it was used as a picture of the universe and the power of the deity (Brunés 1967). In Greece, the doctrine concerning the geometrical form of the universe appears throughout the works of Greek treatises on geometry and philosophy. For example, Pythagorean theories of harmony and music were of concern to both philosophers and craftsmen, such as architects, engineers, painters, etc. (Ferguson 2008, pp. 18–21).

On geometry, Vitruvius wrote simply, “Geometry, also, is of much assistance in architecture, and in particular it teaches us the use of the rule and compasses, by which especially we acquire readiness in making plans for buildings in their grounds, and rightly apply the square, the level, and the plummet” (Vitruvius 1960, p. 6). Although the architect needs geometry, Vitruvius said, to make correct drawings, proportions, and the position of the buildings and solve problems of symmetry, his view of geometry seems to be very focused on the instruments, because in the preface to Book V and IX he emphasizes the importance of geometry and outlines a model of the cosmos, which turns into practical instruction for clock making.

The ancient Greeks also used a uniform system in the disposition of buildings in space that was based on the principles of human cognition (Doxiadis 1972, p. 3; Kanerva 2006). For example, the position of the buildings was determined not only by the angle of vision but also by their distance from the viewpoint. These distances were based on simple geometric ratios derived from the angles of vision, as seen in some passages of the *DA* (Doxiadis 1972, pp. 15–19).

History

Vitruvius recommended that architects know history (*historias*) to explain the meaning of their buildings. The stories were needed because architects often included various ornaments in their work, and they wanted to explain why they introduced certain motifs (Vitruvius 1960, p. 6). Vitruvius provided a couple of examples of the many stories. For example, if the architect puts up male statues to support entablatures, he has to be cognizant of their origin, referring to the story of punished Persian prisoners (Vitruvius 1960, p. 6). Vitruvius also gave a few other examples of this kind of historical etiology, such as the origins of the types of columns (Rykwert 1996, pp. 133–138; Vitruvius 1960, pp. 102–103, 135–136). Barbaro pointed out that the historical motifs with which Vitruvius, according to Barbaro, adorns his books are natural history dealing with timber, winds, and climates, whereas others are exemplary stories on subjects such as the worth of learnedness and the writing on architecture (Cellauro 2000; Kanerva 2006).

To be precise, when Vitruvius recommended that the architect have knowledge of history, he talked about the many stories the architect had to know. The principle of Vitruvius seems to be that the architect has to master the iconography of the architecture or historical symbolism (Briggs 1927, pp. 30–31). In other words, to use an architectural ornament correctly, the architect had to know its meaning, which can be understood from its myth of origin (Plommer 1979; Shear 1999; D’Evelyn 1999).

Philosophy

In ancient Rome, the study of philosophy included a wide range of subjects (Rawson 1985). In the Hellenistic period, philosophy was commonly divided into one of two branches, moral and natural, and Vitruvius wrote about them both:

As for philosophy, it makes an architect high-minded and not self-assuming, but rather renders him courteous, just, and honest without avariciousness. This is very important, for no work can be rightly done without honesty and incorruptibility. Let him not be grasping nor have his mind preoccupied with the idea of receiving perquisites, but let him with dignity keep up his position by cherishing a good reputation. These are among the precepts of philosophy (Vitruvius 1960, p. 8).

From Vitruvius’s point of view, the study of philosophy makes the architect high minded, so that he should not be arrogant but rather tolerant, fair, and trustworthy. Vitruvius used some Latin words without any explanation. Although he says “no work can truly be done without honesty (*fide*), and disinterestedness (*castitate*)” (Kanerva 2006, p. 76), he never gave any detailed information about the actual study of moral philosophy appropriate for the architect. From the original meaning of Vitruvius, Filarete seems to have perfectly understood the passage:

The architect who supervises building operations needs faith. If the architect does not have such a faith, he will not have love (*amore*), and without faith and love in his work, he will

not care about it. He will waste things and money without a second thought. But if he does have faith, he will always be eager to economize and to find useful and fine solutions for the work (Filarete 1965, pp. 198–199).

The other area of philosophy that Vitruvius espoused for study is natural philosophy, which explains the nature of things. In Greece, natural philosophy is called *physica* (physiology), and it is close to what we distinguish as natural science (Rawson 1985, p. 282). Daniele Barbaro distinguished two branches within natural philosophy: natural history and natural science. Natural history, he said, is simply narrations of the effects of nature, and natural science is observing the causes, origins, and principles of all those things in the order and doctrines as discussed by the exemplary natural scientist Aristotle (Kanerva 2006, pp. 80–81; Cellauero 1996, pp. 122–123). Both natural history and natural science are useful for the architect, Barbaro thought (Mitrović 1996; Kanerva 2006). According to Vitruvius, the principles of natural philosophy are as follows:

[P]hysicists and philosophers have set forth that the primordial elements are four in number: air, fire, earth, and water; and that it is from their coherence to one another under the moulding power of nature that the qualities of things are produced according to different classes. And, in fact, we see not only that all which comes to birth is produced by them, but also that nothing can be nourished without their influence, nor grow, nor be preserved (Vitruvius 1960, p. 225).

Through the text of Vitruvius it becomes evident that, from the ancient architect's point of view, the relevant parts of the science were those dealing with properties of water, to the extent that it was needed in hydraulic engineering, and with the quality of things used as building materials (Lewis 1997; Kanerva 2006). Philosophical studies, according to him, were also needed if the architect really wanted to understand the treatises of Archimedes and Ctesibius, the most famous engineers of antiquity, which he thought essential to good architectural practice (Vitruvius 1960, pp. 225–226).

Music

The ancient Greek had no word that corresponded to what we now call music [*Mousikē*]. Music was a more general category for inspired dancing and singing, sometimes accompanied by instruments (Parcell 2012, p. 36). Many writers have suggested that ancient Greek architects used musical proportions as the basis for temple designs, including the Parthenon and the Temple of Zeus at Akragas (Kappraff and McClain 2005; Bell 1980; Jones 2000; Kanerva 2006; Walden 2014). In the *DA*, Vitruvius wrote

Music, also, the architect ought to understand so that he may have knowledge of the canonical and mathematical theory, and besides be able to tune ballistae, catapults, and scorpiones [small catapults] to the proper key. For to the right and left in the beams are the holes in the frames through which the strings of twisted sinew are stretched by means of windlasses and bars, and these strings must not be clamped and made fast until they give the same correct note to the ear of the skilled workman. For the arms thrust through those stretched strings must, on being let go, strike their blow together at the same moment; but if they are not in unison, they will prevent the course of projectiles from being straight (Vitruvius 1960, pp. 8–9).

From Vitruvius's point of view, the principles of music are key to understanding the systems, Vitruvius thought, "which produce

architecture, and machinery that is closer to nature, and thus more beautiful, convenient, and useful" (Walden 2014, pp. 126–127; Scholfield 1958, pp. 17–31). Indeed the term music became practically synonymous with harmony and took on the same breadth of meaning (Lippman 1964, p. 3). It can be mentioned that Plato also believed that harmony and music had a close relation to the cosmos (Lippman 1964, p. 19). In the *DA*, Vitruvius claimed that "both the musical type (*genus*) and the architectural orders originally derive from nature models, which were shaped, refined, and applied in a variety of practical contexts by earlier ancient musicians and architects" (Walden 2014, p. 132; Vitruvius 1960, pp. 109, 141). Vitruvius expected that the architect could use the principles of music in everyday architectural practice. For instance, he mentioned that the three different architectural orders, Doric, Ionic, and Corinthian, were comparable to the musical tetrachords (Vitruvius 1960, pp. 139–142; Jones 2000, pp. 34–44; Scholfield 1958, pp. 21–31; Walden 2014, p. 131). In addition, Vitruvius said that the principles of *harmonia* can be used to design stone theaters. He said that musical abilities were required in the adjusting of theater acoustics (Vitruvius 1960, pp. 139–142). The laws of music also play an important role in the construction and maintenance of mechanical devices used in war (Vitruvius 1960, pp. 308–309).

Medicine and Astronomy

As mentioned before, Vitruvius showed that the architect does not need to master all of the branches of study he recommended in his book. "This is because the *rationes* of every discipline rely on the same set of common principles" (Walden 2014, p. 142; Vitruvius 1960, p. 9). Vitruvius took music as an example of how it can share theories with medicine as well as astronomy. His suggestion was clear: "if the theoretical rules of music can be applicable to fields as different as these, they can be applicable to architecture as well" (Walden 2014, p. 142; Vitruvius 1960, pp. 9–10). According to him, an optimal site for a dwelling provided the conditions in which the four elements of a human body could be kept in balance. If one of them, heat, for instance, becomes predominant, it destroys and dissolves all the others with its violence. On the whole, knowledge of medicine was needed, because of the problems in architecture relating to climate, air, the matter of health related to various sites, and the qualities of water (Vitruvius 1960, p. 10; Scarborough 1969, pp. 66–75; Kanerva 2006).

Vitruvius expected that in astronomy and music theory, analogous numerical and proportional relationships can be found; he explained that "astronomers likewise have a common ground for discussion with musicians in the harmony of the stars and musical concords in tetrads and triads of the fourth and the fifth [...]" (Vitruvius 1960, p. 12). From this point of view, astronomy was useful in constructing sundials, and according to him, the architect needed basic astronomical knowledge: east, west, south, and north, the principles of the heavens, and the course of the stars (Vitruvius 1960, p. 10). He also explained the principles: the zodiac and the planets, phases of the moon, and constellations (Vitruvius 1960, pp. 257–265). In addition, Book IX deals with astronomy. He pointed out that the cosmos is the all-encompassing system of everything in nature. Two perpendicular axes have divided the sky into four parts, and their names are *decamanus* (north–south direction) and *cardo* (east–west direction). The sky, which is formed of the constellations, also moves around the earth and sea at the two hinges of the axis. Therefore, nature has acted as architect. He described the universe as an architectural design, in which the laws of the cosmos and of architecture are clearly regarded as identical (Vitruvius 1960, pp. 257–258; Jones 2000, pp. 38–45). This idea comes from Plato's *Timaeus*. It became not only the model for science but

also the model for architectural theory (Pérez-Gómez 2006, pp. 147-148).

Law

For the ancient Romans, learning to think was more important than just thinking. Therefore, because the study of law in ancient Rome was an intellectual activity, it was held in the highest respect by the Roman upper class (Rawson 1985, p. 201). For Vitruvius, it was clear that the architect needed to have knowledge of laws. He advised the architect to take care that the building would be executed according to relevant laws and statutes, without causing any disputation with the neighborhood or other parties. Therefore, he considered it especially important that the architect be familiar with the law governing the things that are necessary if buildings have party walls: the courses of rain gutters and drains, lighting, and water supply (Vitruvius 1960, p. 10). Knowledge of law is also necessary for the architect when he writes contracts (Vitruvius 1960, p. 10). That is, the building contracts included many questions regarding Roman law, and the architect should have known how to answer them (Vitruvius 1960, p. 10). Also, the building contract was divided into one of two types: *stipulatio*, which meant a legal form by which a promise made by one party to another was enforceable, and *locatio conductio*, which was the general term for any kind of contract involving hire and lease (Martin 2001, pp. 107-129; Anderson 1997, pp. 68-118). They were regularly handled by forming a legally binding contract between the landowner and the architect.

Conclusion

This study of Vitruvius's ideas about the education of the architect in the first century BCE in Rome leads to two concluding thoughts. First, Vitruvius's recommendation for the education of the architect deals with both practical experience and theoretical knowledge. Consider his description that architecture is a branch of science that relates to both liberal and mathematical arts. Essentially, it is a building science in which the design and construction aspects both must have a rationale. As a result, from his view, there is no way to separate the two disciplines of architecture and engineering.

Second, Vitruvius lays out nine areas of learning that he thinks are essential for the architect, although some of the definitions have often been misunderstood. For him, writing and drawing are two sides of the same coin, because they deal with giving instruction to the builder. However, the *scaenographia* (shadow drawing) technique, which is a part of drawing, is not characteristic of perspective but of color systems relying on optical fusion. His view of geometry, music, and astronomy seems to be very focused on the instruments. Those disciplines can assist the architect to make correct drawings, proportions, and position of the buildings and solve problems of symmetry. Vitruvius recommends that the architect know history to use an architectural ornament correctly and know its meaning, which can be understood from its myth of origin. The architect also needs philosophy, medicine, and laws to understand the quality of materials, the problems in architecture relating to climate and air, and the building contracts, respectively.

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