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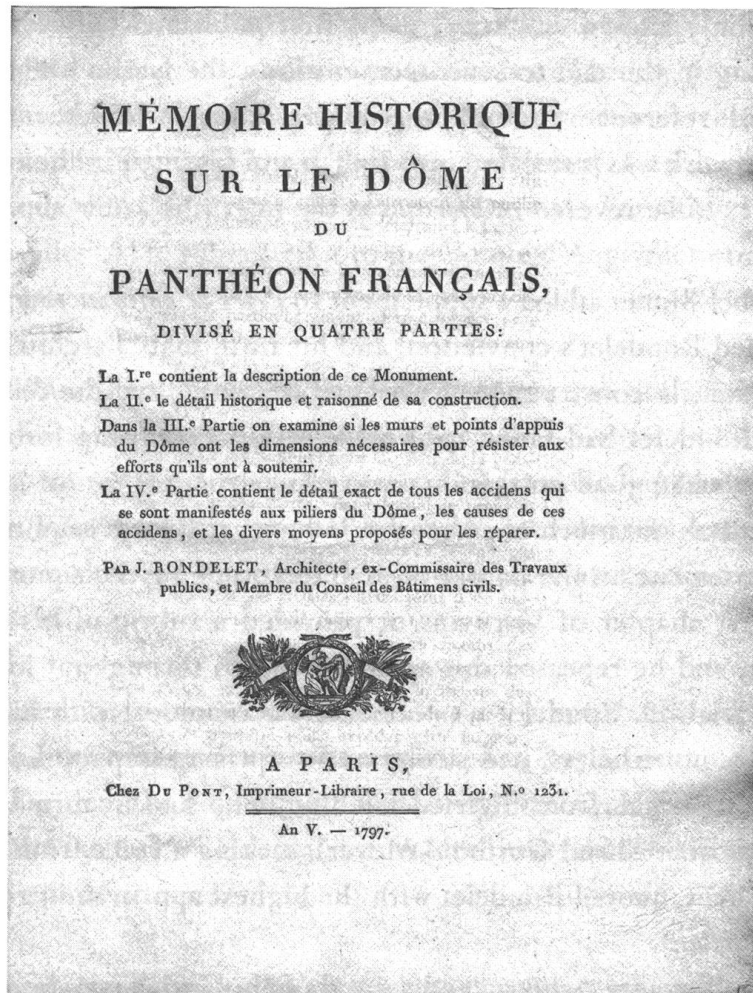
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JEAN RONDELET AS THEORIST

Robin Middleton

Jean Rondelet, *Mémoire Historique sur le Dôme du Panthéon Français*, divisé en quatre parties ..., Paris: Du Pont 1797, title

Jean Rondelet was not much of an architect. He is known to have erected only one building to his own design – a narrow apartment block on the rue de Bourbon (2–4 rue de Lille), Paris, put up in 1780, surviving still, though altered, quite undistinguished.¹ Yet he was deeply respected as the expert who had seen the greatest church of the eighteenth century, Jacques-Germain Soufflot's Sainte-Geneviève, known as the Panthéon, through to com-

pletion and, he had, moreover, saved it from collapse in the early nineteenth century when the four main piers of the crossing were found to be cracking. He coarsened the architecture. He was appointed architect to the building only in 1806, when he was sixty-two, on Pierre-François-Léonard Fontaine's recommendation to Napoleon. His technical expertise was to be enshrined in a long and compendious study, the *Traité théorique et pratique de l'art de bâtir*, commonly known as *l'Art de bâtir*, first published between 1802 and 1817, running in the end to seventeen editions, the last in 1885. This was the standard reference to building construction in nineteenth century France. The work was translated into Italian and German in the early 1830s. Rondelet was to be revered in Europe as the man who knew about building construction.

When Abel Blouet added a supplement to *l'Art de bâtir* in 1847 and 1848, he proclaimed Rondelet's conviction, and his own, that "l'architecture, c'est la construction; la construction, c'est l'architecture"², yet he felt bound to admit that Rondelet had failed to provide a full accounting for that belief. He hoped to make good on this.

Rondelet was not much of a theorist. Whenever he was required to make a general statement on the nature of architecture, he either quoted directly from the first chapter of Vitruvius or provided a rubric of his own based on that text, and he repeated this again and again throughout his life, with very little variation. Rondelet was extremely economical with his thoughts. But his ideas, nonetheless, had strong and surprising impact. Le Corbusier himself (taking a cue from Sigfried Giedion, who had in turn taken a cue from the historian Alfred Gotthold Meyer), seeking a voice from the past of mechanical bent, quoted Rondelet with the highest approval, in 1928, in *Une maison – un palais*³.

Giuseppe Terragni (who owned a copy of Le Corbusier's book) likewise heralded Rondelet's beliefs (as interpreted though by Rondelet's translator), scribbling in the margin of the introduction to his *Trattato teorico e pratico dell'arte di edificare* "Razionale".⁴ Limited though it was, Rondelet's theory clearly requires some attention.

Rondelet first recorded his concept of architecture in a letter of January 1783, addressed to the Comte d'Angiviller, Directeur des bâtiments du roi, requesting a grant to travel to Italy to inspect the works of the Romans – even before his journey he saw a continuity in the building traditions of the ancients and the moderns.

“J’ai toujours pensé que le but de l’architecture étoit de réunir sous les plus belles formes, et les plus justes dimensions, toutes les parties essentiellement nécessaires à l’objet pour lequel on se propose de bâtir, et de n’employer à leur construction, qu’une suffisante quantité de matériaux choisis, et mis en œuvre avec art et Economie, dans les moins tems possible.”⁵

Rondelet was in Italy from May 1783 to December 1784. Soon after his return, he drafted a long “Mémoire sur l’architecture” (thirty pages), which he revised and reduced to seven pages as a “Mémoire sur l’architecture et la construction des Edifices, considérés généralement, avec le projet d’une Ecole pratique d’Architecture, qui serait chargée de l’exécution de tous les ouvrages publics”.⁶ He submitted it to the Comte d’Angiviller on 3 July 1786. This time he wrote:

“Le But de l’architecture est en general, de construire des edifices commodes et solides, qui réunissent sous les plus belles formes et les plus justes dimensions, toutes les parties relatives à l’objet pour lequel on se propose de les bâtir. Pour parvenir à ce but les architectes divisent leur art en trois parties principales qui sont: la Distribution, la Construction et la Décoration.”⁷

Rondelet, notably, reversed the order of the parts established in Jacques-François Blondel’s *Cours d’architecture* of 1771 to 1777, setting decoration at the end rather than the beginning. In addition, he complained at some length that, with the revival of classical forms, architects had become decorators rather than constructors.

“Depuis le renouvellement de l’architecture grecque, les architectes se sont trop occupés de la Décoration, ils ont fait de cette partie qui n’est qu’un accessoire, un objet principal; cet abus vient de ce que lorsqu’on abandonna l’architecture gothique, les premiers architectes ne furent que des peintres ou des dessinateurs qui ne s’attachèrent qu’à la décoration, parce qu’elle ne trouvoit plus à leur portée que les deux autres parties, qui demande des connoissances des arts et des usages auxquels les edifices doivent être destinés. C’est pour cette raison que leurs productions sont, la plupart, que des massifs décorés, qui n’ont aucun rapport à la distribution ni à la construction, d’où il est résulté une architecture lourde et dispendieuse ou tout est assujéti au caprice du Decorateur.”⁸

His conclusion was much to be expected:

“La plus part de nos architectes étant plus decorateurs que constructeurs, connoissent à peine les arts qu’il faut mettre en œuvre pour executer leurs projets.”⁹

D’Angiviller was not minded to take up Rondelet’s proposals for a school where competent and informed administrators and craftsmen might be trained to take charge of all public building. Unabashed, in 1790, after the Revolution, Rondelet published a further revised version of the paper, *Mémoire sur l’architecture considérée généralement, avec des observations sur l’administration relative à cet art, et le projet d’une Ecole Pratique, qui seroit chargés de tous les ouvrages publics*, and presented it to the Assemblée Nationale for consideration.

The aim of architecture was once again described almost exactly as before, though the word “essentiel” was added after “but”.¹⁰ Architecture was now to be clearly distinguished from the other arts such as poetry, painting, sculpture and music:

“L’architecture est au contraire, un art essentiellement utile, qui exige beaucoup de connoissances, de prudence et d’habilité pour allier dans un même édifice, la beauté, la commodité, la solidité et l’économie.”¹¹

There was, as before, no immediate response to Rondelet’s suggestion for a school to be organized on military lines – Roman military lines. Undaunted, he incorporated much of his *Mémoire* into a proposal of 1794 for an École centrale des Travaux publics, though the final proposal for this, presented to the Convention on September 24 and 28, 1794 was the work of Gaspard Monge and the chemist Antoine-François Fourcroy. Some of Rondelet’s ideas were included.¹²

Rondelet had other opportunities during these years to repeat his definition of architecture. He was asked by Antoine Chrysostôme Quatremère de Quincy to write the technical articles for Panckoucke’s *Encyclopédie méthodique. Architecture*. The first volume, containing the article “Bâtir (art de)”, was published in 1788. Rondelet began, as required, with a definition:

“L’art de bâtir est distinct de l’architecture & de la science de la construction. L’art de bâtir est né du besoin: l’art de l’architecture naquit du plaisir. La

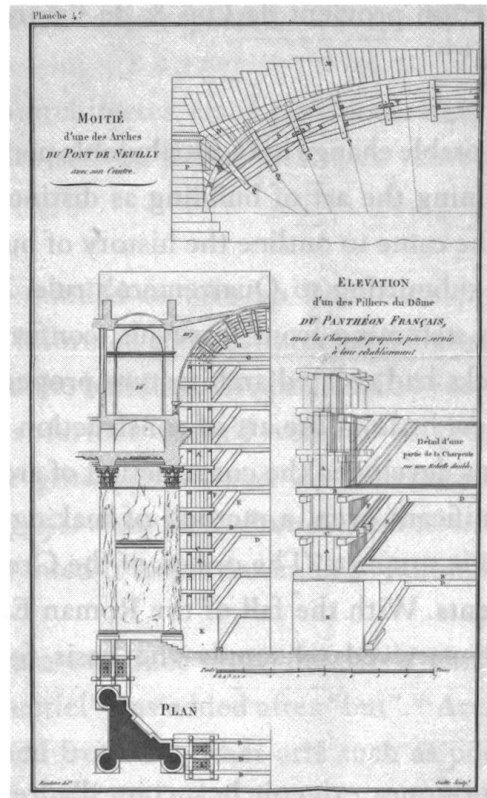
science de la construction provient de l'un & de l'autre, & de l'application des sciences du calcul."¹³

There is, of course, a notable change here, attributable perhaps to Quatremère's editorial hand, in defining the art of building as distinct from the art of architecture. But when he came to outline the history of building, Rondelet was far, in the end, from submitting to Quatremère's rule. He accepted, readily enough, the tradition stemming from Vitruvius, confirmed by Julien-David Le Roy, that the Greeks had created architecture proper, but, like the Egyptians before them, knew little of the art of construction – nothing of *la coupe des pierres*. The Romans developed the construction of arches and vaults of cut stones and, more significant even, a method of making them of rubble and mortar at one with their supports. The orders of the Greeks became no more than decorative elements. With the fall of the Roman Empire such expertise was lost, but enough survived to supply the basis for a new manner of building:

“*L'art de bâtir* des Gothiques exigeoit beaucoup d'adresse & d'intelligence. Les architectes du douzième siècle surent distinguer avec une sagacité étonnante les parties principales de leurs édifices, qui en forment, pour ainsi dire, l'*ossature*, d'avec les parties intermédiaires, qui n'en font que le remplissage. Ils ont employé pour l'*ossature* la construction en pierres de taille, dont la force & la résistance pouvoient seuls assurer la solidité de leurs édifices, à cause de la hauteur, de la légèreté & de l'isolement des points d'appui. Mais ils ont mis en œuvre le moilon pour les remplissages & les *élégissemens*, par-tout où le massif n'étoit pas nécessaire. Par ce moyen, ils vinrent à bout de réunir dans leurs édifices la solidité à l'économie. On n'y trouve rien de trop, rien d'inutile, & qui ne fasse partie essentielle du tout.”¹⁴

But for all his high regard for Gothic, Rondelet made evident in other articles in the *Encyclopédie* that he had little liking for the thrusting and buttressing elements of the architecture. Gothic cathedrals appeared to him to be encased in scaffolding. Internally, however, he was compelled to acknowledge that they aroused feelings that he could scarcely define:

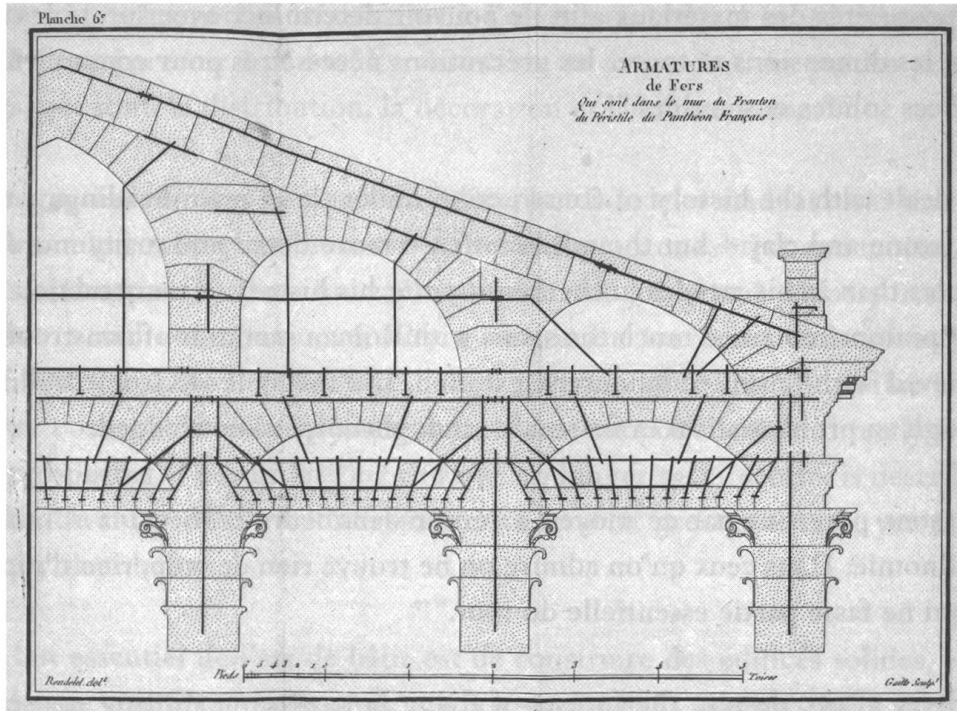
“L'intérieur [...] des belles églises gothiques, telles que celle d'Amiens, offre un aspect plus grand, plus noble, plus *un* & plus varié que celui de la plupart de nos églises modernes, bâties en arcades et décorées d'ordre d'architecture.”¹⁵



“Moitié d’une des Arches du Pont de Neuilly avec son ceintre.”, above, and “Elevation d’un des Piliers du Dôme du Panthéon Français, avec la Charpente proposée pour servir à leur rétablissement”, below, in: Jean Rondelet, *Mémoire Historique sur le Dôme du Panthéon Français, divisé en quatre parties ...*, Paris: Du Pont 1797, plate 4

This is a surprising assessment to find in the *Encyclopédie*. Quatremère loathed Gothic with a rare intensity, though he was able to admire the Camposanto in Pisa. But it was the development of the stone-cut arch that, in Rondelet’s estimation, raised architecture to a climax, soon to be undermined by the quest for elaboration and the demonstration of overwrought skill in the setting of stones. Rondelet disliked all expression of the dynamics of structure – as he made quite explicit in articles such as *Appareil*, *Arrièrevousure* and *Bander*.

In April 1802 Rondelet submitted an essay to the Institut national des sciences et arts in response to a call of the previous year – “Examiner quels ont été, chez les differens peuples, les progrès de cette partie de l’architecture que l’on appelle *la science de la construction des edifices*, depuis les temps les plus reculés jusqu’à nos jours.”¹⁶ The draft of Rondelet’s essay survives – 93 pages.¹⁷ This



“Armatures de Fers qui sont dans le mur du Fronton du Péristyle du Panthéon Français.”,
in: Jean Rondelet, *Mémoire Historique sur le Dôme du Panthéon Français*,
divisé en quatre parties ..., Paris: Du Pont 1797, plate 6

adds little to our knowledge of his thoughts, but it does serve to summarize, yet again, his firmly held beliefs. The essay is concerned with the nature of materials and the history of their use rather than the science of construction, and the emphasis remains on the practice of the ancients. Over four pages are quoted at the start from the first chapter of Vitruvius, the French and Latin in parallel, with a summary to follow to explain his intent.

“Il s’agit d’examiner les progrès les plus connus sous le nom de théorie. C’est le résultat du raisonnement et de l’expérience, soumis aux principes de physique et de mathématique. Un constructeur habile qui possède bien la théorie, peut rendre raison de tous les moyens qu’il propose pour donner à un edifice toute la solidité et la perfection dont il est susceptible, en y employant les matériaux les plus convenables, mis en œuvre avec art et économie; et comme on ne peut raisonner juste et conséquemment que sur les choses que l’on connaît à fond, il en résulte qu’un bon constructeur doit réunir aux connaissances de physique et de mathématique celle des différens procédés employés par les anciens et les modernes, et doit aussi connaître la nature et

les propriétés des matériaux afin de pouvoir déterminer avec sûreté les formes, les dimensions et toutes les précautions nécessaires pour construire des édifices solides et durables.”¹⁸

He dealt with the history of construction under three main headings – timber, stone and clay – but though he offered more detail and many more examples than in his articles in the *Encyclopédie*, his history of construction and his opinions remained much the same, with Roman methods of construction, achieved with unskilled labourers, extolled, and the skill of Gothic builders, though so problematical in its results, thoughtfully acknowledged:

“Ils sont parvenus par ce moyen à réunir dans leurs edifices, la solidité à l’économie: Dans ceux qu’on admire on ne trouve rien de trop, rien d’inutile et qui ne fasse partie essentielle du tout.”¹⁹

And yet again, despite the forests of flying buttresses unstinting praise for the internal effects of the Gothic cathedrals – “ou il règne une unité d’ensemble qui excite l’admiration”²⁰ – and so forth, to recount the rise and fall of stereotomy. Only on the last two pages did Rondelet even allude to the major seventeenth and eighteenth century advances in the science and calculation of structures. His conclusion was even more inapposite:

“La science de la construction n’est pas susceptible d’une aussi grande variété que la décoration et la distribution, qui ont plus de rapport aux mœurs, et des usages des differents peuples. Les bases et les procédés sont à peu près les mêmes pour un edifice Egyptien, Chinois, Grec ou Gothique, surtout quand il est de même genre et formé de mêmes matériaux.”²¹

There was nothing on iron construction. Rondelet shared the prize with an engineer, also from Lyon, Griffet de La Baume. One wonders who the judges might have been. They are unrecorded.

The most manifest of Rondelet’s writings was the *Traité théorique et pratique de l’art de bâtir*. The prospectus for this was issued in 1799. It contains some familiar phrases:

“Le but essentiel de l’architecture est de construire des édifices commodes et solides qui réunissent, sous les plus belles formes et les plus justes dimen-

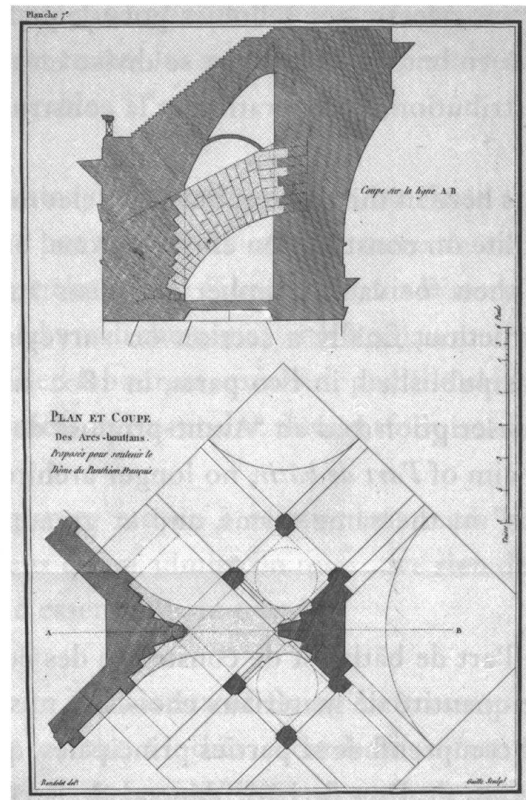
sions, toutes les parties nécessaires à l'objet pour lequel on se propose de bâtir. Pour parvenir à ce but, l'architecture se divise en trois parties principales, qui sont, la distribution, la décoration et la construction."²²

Construction remains here in third place, but Rondelet made it clear that his book would concentrate on construction entire – stone, brick and mortar for walls and supports, then for vaults; timber for joists and trusses; iron for hardware and construction, finally a section on surveying and estimating. The first volume was published, in two parts, in 1802 and 1803. The front matter contained a description and an "Avant-propos" derived directly from the prospectus. The aim of *l'art de bâtir*, no longer architecture, is described in the "Avant-propos" in the same terms, and at greater length, yet more sharply than before:

"Le but essentiel de l'art de bâtir est de construire des édifices solides, en y employant une juste quantité de matériaux choisis et mis en œuvre avec art et économie. Cet art comprend deux parties principales, qui sont la *théorie* et la *pratique*; la perfection de l'art de bâtir dépend de la réunion de ces deux parties. La pratique, qui est la plus ancienne, est l'art d'extraire les matériaux, de les transporter, de les façonner et de les mettre en œuvre pour l'exécution d'un ouvrage quelconque.

La théorie est une science qui dirige toutes les opérations de la pratique. Cette science est le résultat de l'expérience et du raisonnement, fondé sur les principes de mathématiques et de physiques appliqués aux différentes opérations de l'art. C'est par le moyen de la théorie qu'un habile constructeur parvient à déterminer les formes et les justes dimensions qu'il faut donner à chaque partie d'un édifice, en raison de sa situation et des efforts qu'elle peut avoir à soutenir, pour qu'il en résulte perfection, solidité et économie."²³

The remainder of the "Avant-propos" was taken up with an outline of the contents of the books to follow, with a hint as to the practical application of theory to construction in the fifth of the books. The first book, however, opened with ten pages devoted to the "Idée de l'architecture", with a brief description of the different types of architecture – civic, military and naval – and a nod at the history of Greek and Roman architecture, to end in some general remarks and a reiteration of the contention that architecture, unlike painting and sculpture, was not made for pleasure alone:



“Plan et Coupe Des Arcs-bouttans. Proposés pour soutenir le Dôme du Panthéon Français”,
in: Jean Rondelet, *Mémoire Historique sur le Dôme du Panthéon Français*,
divisé en quatre parties ..., Paris: Du Pont 1797, plate 7

“L’architecture est une science dont le but essentiel est de construire des édifices solides et commodes, qui réunissent sous les plus belles formes toutes les parties nécessaires à leur destination.”²⁴

There was no advance in Rondelet’s thinking. He was, indeed, closer than ever before to Vitruvius. Not surprisingly, he opened his fifth book, with its section “De la théorie”, with a page and a half quoted directly, in Latin and French, from the first chapter of Vitruvius – he owned Barbaro’s Latin edition of 1567. Rondelet translated Vitruvius thus:

“L’architecture est une science qui comprend plusieurs préceptes et diverses connaissances, au moyen desquels elle peut apprécier les ouvrages des autres arts qu’elle dirige; cette science est le résultat de la pratique et de la théorie. La pratique est l’objet des opérations manuelles nécessaires pour donner à la matière la forme qu’elle doit avoir, pour quelque genre d’ouvrage que ce soit.

La théorie est la science qui peut expliquer et démontrer les procédés et les proportions exécutés ...”²⁵

Rondelet offered little more by way of expansion of these ideas, certainly nothing that he had not already propounded more than once, though he did make clear that his focus now was on construction itself:

“Nous n’avons à considérer, dans ce traité, que la théorie qui a rapport à la construction. L’objet de cette partie essentielle de l’art de bâtir est d’examiner les parties d’un édifice relativement à la solidité; d’examiner les moyens d’exécution et d’économie, en ayant égard à l’espèce des matériaux, à leur nature, leur propriété et la manière dont ils sont mis en œuvre.”²⁶

Theory, as might be imagined, is soon subsumed in mathematics. The volume is devoted to the design of foundations, walls and piers, buttresses and retaining walls and, at greatest length, to vaults. There are many quotations from Vitruvius, and many examples from antiquity, though Rondelet does range widely through to the present to include not only St. Paul’s and the Panthéon, but also the cathedrals of Paris and Milan. There is not much more, one might note, in *l’Art de bâtir* on Gothic, nothing of the keen interest evident in the *Encyclopédie méthodique*. He cites the formulae of La Hire, Belidor, Frézier and others, but most are of his own devising. Couplet’s mathematics is dismissed as impractical. Coulomb is not mentioned. Rondelet demonstrates at great length how formulae are to be worked out, with additional tables for summary sizing. There is little more theory in this or the remaining volumes. And nothing more was to be added in the next four editions.

The school of architecture initiated by the Académie royale d’architecture survived the Revolution as the École d’architecture. Rieux, who was responsible for the course on construction, continued as “professeur de stéréotomie” until he died in February 1806. On 31 May Rondelet was appointed his successor as “professeur de la construction”, a position he retained when the school was reformed in 1819 as part of the École royale et spéciale des beaux-arts, installed at first in the Collège des quatre nations and, after 1829, in the new buildings of the École des beaux-arts.

Rondelet’s inaugural lecture, of 1806, was duly published as *Discours pour l’ouverture du cours de construction et stéréotomie*. Whole paragraphs from the *Mémoire sur l’architecture considérée généralement* of 1790 and, thus, on occasion, from the first draft of the “Mémoire” to the Comte d’Angiviller

of 1785, as also the article “batîr (art de)” in the *Encyclopédie méthodique* of 1788, not to mention the prospectus and introduction, etc. of the *Art de bâtir* itself, were rearranged, spliced together and repeated yet again, with hardly a word having been changed. The distinction between theory and practice is explained yet again, the division of architecture into the three basic parts, planning, decoration and construction, reiterated, as also something of its historical development.

“L’architecture,” one reads, “n’est pas, comme la peinture et la sculpture, un art dont l’unique objet soit de plaire, dans lequel l’artiste, exécutant lui-même son ouvrage, peut se livrer à tout le feu de son imagination; c’est une science dont le but essentiel est de construire des édifices solides et commodes, qui réunissent sous les plus belles formes toutes les parties nécessaires à leur destination.”²⁷

This formula is repeated again, a page later.

“Nous avons déjà dit que le but essentiel de l’art de bâtir est de construire des édifices solides, en y employant une juste quantité de matériaux choisis et mis en œuvre avec art et économie.”²⁸

Le Corbusier was to compose his quotation from this work in much the same manner as it was written, taking sentences from different pages and confidently changing “l’art de bâtir” to “architecture”.

The course Rondelet summarized for his students was, as might be expected, a summary of *l’Art de bâtir*.

When the king approved the new regulations for the school in 1819, Rondelet delivered a paper to the Section d’architecture that he wrote in response to an urgent demand from the ministre de l’Intérieur that students’ progress be monitored by a system of marks. Rondelet was all for this. He was also eager that their progress be marked by an advance in knowledge of mathematics and structures. Unabashed, he defined once again the parameters of architecture:

“L’architecture n’est pas un art comme la peinture et la sculpture, dont l’unique objet soit de plaire, et dans lequel l’artiste exécutant lui-même son

ouvrage peut se livrer à tout le feu de son imagination; c'est une science dont le but essentiel doit être de construire des édifices solides, qui réunissent sous les plus belles formes et les plus justes dimensions toutes les parties nécessaires à leur destination [...]"²⁹

The keys to this control were mathematics and, now, drawing.

By 1822 Rondelet was quite blind. But with two assistants, Desalle, little known, and Adolphe-Marie-François Jäy (L.-P. Baltard's son-in-law), he continued teaching for two further years. He died on 27 September 1829, aged 87. During his final years he determined on a drastic reorganization of *l'Art de bâtir*. He was to be greatly aided in this by his son, Antoine.

A prospectus, sixteen pages long, was issued for the revised fifth edition, "revue par l'auteur", in 1827.³⁰ The first volume was promised for late July. The prospectus comprised an outline of the history of architecture together with the table of contents intended. The first volume was issued, as promised, in 1827. The essay of the prospectus had become the "Introduction", replacing the "Avant-propos" and the "Idée de l'architecture" of the previous editions. Three volumes, at least, of this edition were published, in 1827, 1828 and 1829, before yet another prospectus, of twenty-nine pages, for a sixth edition, was issued in January 1830: Rondelet had already been dead for three months, and the work was still described as "revue par l'auteur".³¹ The last two volumes of the fifth edition seem to have been overtaken by those of the sixth edition, none has been traced.

The text of the new prospectus, some minor adjustments and punctuation apart, was the same as that of the previous one, but it was printed now with a Latin translation in parallel. This, in turn, became the introduction for the sixth edition (the first four volumes issued in 1830, the fifth in 1832), indeed, all subsequent editions, replacing, as before, the "Avant-propos" and the "Idée de l'architecture". Though Rondelet was blind when this text was first composed, and though the footnotes were to be reinforced with quotations and some marginally revised for the sixth edition (most notably with the substitution of Augustin Thierry's code word "affranchissement" for "entière liberté") – the work, no doubt, of Antoine – there can be no demur that the new introduction was written by Rondelet. He was not one to give way. He must also be credited with the Latin; his Latin would still have been at a peak, his translation of Frontinus' *De aquis urbis Romae* being

published only in 1820. The introduction may be regarded as Rondelet's final summation.

The historical survey is much as before, but sharper by far – practical needs determine the form of the first shelters and the technical knowledge evolved is used to erect places of worship, but such knowledge becomes art only through the application of intelligence:

“Indépendamment du degré de richesse du sol en matériaux propres à bâtir, cet art paraît d’abord plus près de sa perfection, là, où le raisonnement, bien plus que la simple pratique, vient présider à ses premières combinaisons.”³²

The Egyptians produced structures of great strength, but this was achieved, Rondelet thought, through instinct rather than intelligence. At all events there was little development in their skills. The Greeks brought architecture to a form of perfection, but, he opined, they had been led into error in imitating timber forms in stone:

“Trop judicieux pour s’aveugler entièrement sur la fausse route qu’ils prenaient, on les vit s’appliquer à faire disparaître, à force d’art, les contradictions choquantes que présentait, à chaque instant, cette étrange métamorphose.”³³

The Greek art of building was, ultimately, to be judged as little different from that of the Egyptians, but whereas the Egyptians had accepted the reality of their operations, the Greeks had falsified them, imitating the forms of timber in stone.

The heroes of architectural history were the Romans; they had evolved the arch and vault of stone and had liberated themselves thereby from the measurements and proportions of the orders. They had gone even further. They had developed an arcuated system at one with its supporting elements, the whole made of no more than bricks or rubble and mortar. The building that attested to the greatest development was the Basilica of Maxentius:

“L’architecture n’avait peut-être jamais rien produit de comparable; et pour ne parler de son mérite que sous le rapport de l’Art de Bâtir, quelle immensité d’espace couvert! quelle étonnante justesse de proportions entre les

murs, les points d'appui et les voûtes! et en même temps la garantie d'une durée qui paraît n'avoir de terme que celle même de la matière!"³⁴

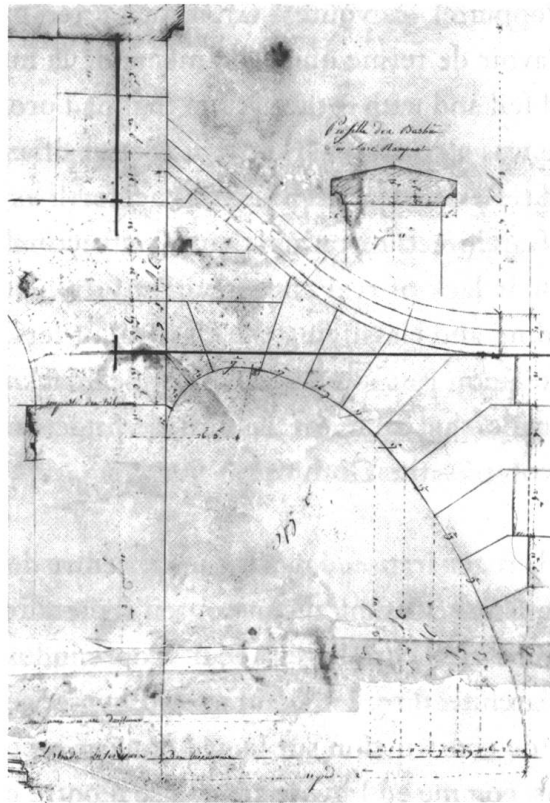
Rome declined and fell and with it the system that had produced architecture of this kind. There was a revival, perhaps, in the art of antique architecture in the building of St. Peter's, but architects henceforth explored the decorative possibilities of architecture rather than its structural dimension. They compensated for their lack of real endeavour in formulating grandiloquent theories and recording and classifying the classical orders, imposing a sacrosanct system of taste upon Europe. But this, Rondelet acknowledged, was not the full story. Outside the orbit of classical architecture another form of architecture had evolved – the Gothic:

"Avant l'époque de la régénération des arts dans le centre de l'Italie, les peuples les plus éloignés de Rome n'ayant aucun conseil à prendre dans les ouvrages de leurs prédécesseurs, et encore livrés à leur propre industrie, étaient parvenus à se créer une architecture. Ici, comme en Égypte, cette art offre dès le principe, le système de construction sur lequel doivent reposer désormais toutes ses compositions; comme en Égypte aussi, il se montre préoccupé d'assurer la plus grande durée à ses ouvrages; mais au lieu de masses péniblement entassées, comme chez ce dernier peuple, l'art de bâtir opéra, la plus ordinairement, avec des matériaux que les Égyptiens auraient rebutés; et guidé seulement par une mécanique pratique, il parvient pas à pas aux résultats les plus inouïs."³⁵

Rondelet seems to have surprised himself by his unreserved praise for Gothic. He felt further explanation was required.

"S'il était besoin de justifier cet éloge de l'architecture gothique, il suffirait de rappeler comment, au moyen de formes et de combinaisons, la matière seule, par le double effort de sa pesanteur et de sa résistance, vient composer les ensembles les plus stables, indépendamment de la force d'union du ciment, qui ne prête qu'un faible secours aux constructions en pierre de taille; comment ensuite, par de sages dispositions, elle sait procurer une longue durée à des matières périssables; comment enfin, au milieu d'un système où tout est en action, rien cependant ne paraît fatiguer à l'œil, ni dans l'ensemble ni dans aucune de ses parties."³⁶

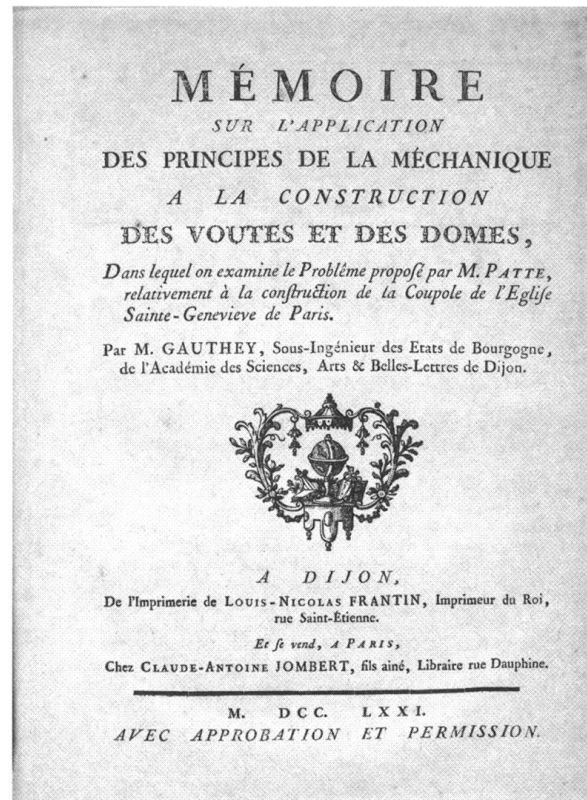
He ended his exegesis of Gothic on a note worthy of Viollet-le-Duc himself – Viollet-le-Duc then scarcely in his teens.



Jean Rondelet, Drawing of the iron reinforcing rods in the flying buttresses of Sainte-Geneviève (AN CP56 A13 139)

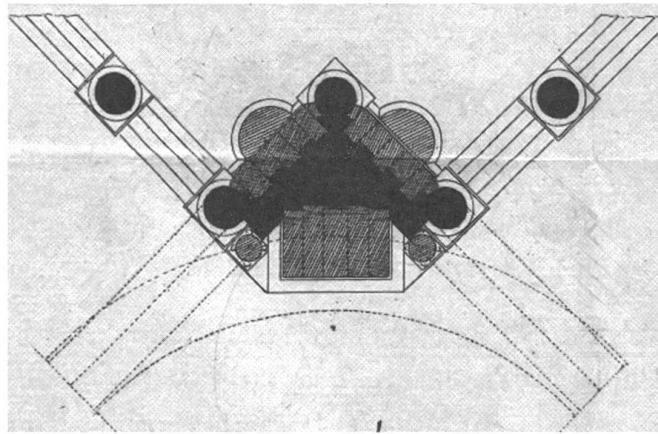
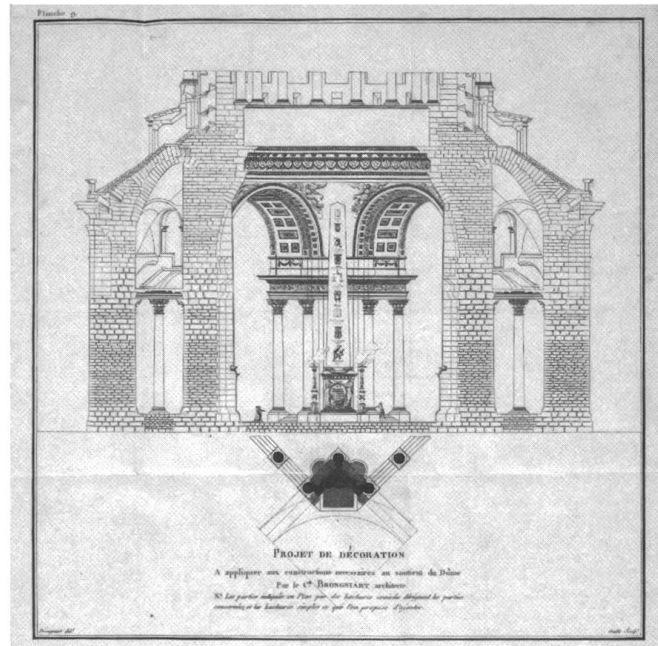
“On ne peut s’empêcher de regretter de voir un système de construction si bien approprié aux ressources et à la nature de notre climat, qui pourroit convenir encore en tant de circonstances, entièrement abandonné de nos jours.”³⁷

This strikes an altogether new note. But for all his new found concern, Rondelet had scant understanding of the workings of Gothic architecture. He was, of course, well aware of the intent of Soufflot and his friends to infuse something of the finesse of Gothic construction into contemporary architecture. Indeed, it was Rondelet, not Maximilien Brébion, as is sometimes thought, who encapsulated Soufflot’s intent: “Le principal objet de M. Soufflot en batissant son Eglise”, Rondelet wrote in a report to the comte d’Angiviller in 1780, just after Soufflot’s death, “a été de reunir sous une des plus belles formes la legereté de la construction des edifices gothiques avec la pureté et la magnificence de l’architecture greque”³⁸. Soon after he began working for Soufflot, in April 1772, Rondelet was sent on Soufflot’s behalf to



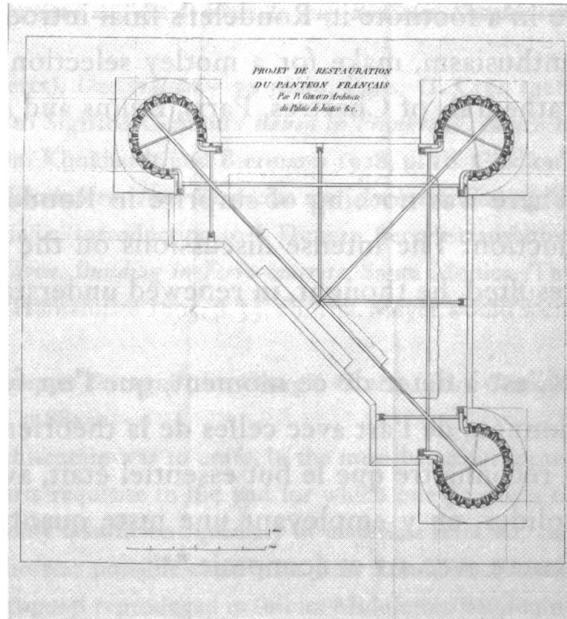
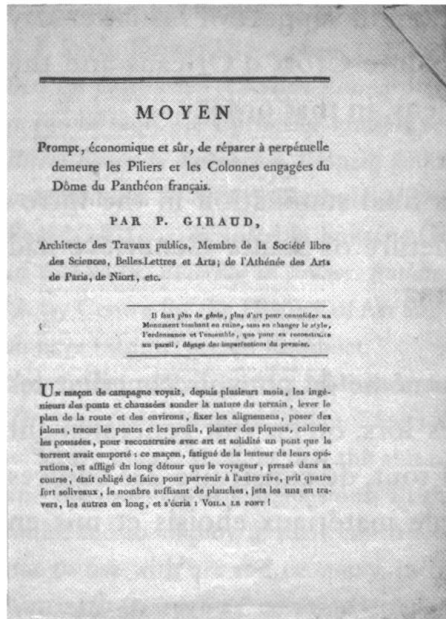
Emiland-Marie Gauthey, *Mémoire sur l'Application des Principes de la Mécanique à la construction des voutes et des domes, Dans lequel on examine le Problème proposé par M. Patte, relativement à la construction de la Coupole de l'Eglise Sainte-Genevieve de Paris*, Dijon: l'Imprimerie de Louis-Nicolas Frantin 1771, title

Châteauvillain (Haute Marne), to consult with the local agent on the rebuilding of the choir of the church of Nôtre Dame, recently collapsed, and the erection of a new west front.³⁹ After Rondelet's return Soufflot sent drawings for the new work, including those for the flying buttresses. These were built and survive. But one cannot be sure if, and how they were reinforced. The drawings remain to be traced. However, a few years later, in 1778, Rondelet was charged with erecting the flying buttresses for Sainte-Geneviève itself.⁴⁰ The drawings for these exist. They give evidence of a total lack of knowledge of the workings of a flying buttress. Iron reinforcing rods were to be inserted, but not, as one might expect, on the line of gravity, rather in an H formation. Rondelet saw all lines of force, in good construction, as vertical and horizontal. He remained, in essence, a column and lintel man. He was always mistrustful of the most intrepid and best informed on Gothic architecture of Soufflot's associates, Emiland-Marie Gauthey. And later, in 1796, when they were in opposing camps – engineers versus architects – on the committees



Alexandre Théodore Brongniart, “Projet de Décoration. A appliquer aux constructions nécessaires au soutien du Dôme ... Les parties indiquées au Plan par les hachures croisées désignent les parties conservées, et les hachures simples ce que l'on propose d'ajouter.”, in: Jean Rondelet, *Mémoire Historique sur le Dôme du Panthéon Français, divisé en quatre parties ...*, Paris: Du Pont 1797, plate 9 with detail of the proposed additions

set up to determine how Sainte-Geneviève was to be saved from collapse, it was Gauthey who again and again remarked on Rondelet's scant understanding of the action of loads. Rondelet persisted in regarding the pendentives of the dome as simple cantilevers, and his analysis of the working of flying buttresses was to both the engineers and the mathematicians altogether incomprehensible. Rondelet claimed, as a rule of thumb, that to be effective, a flying buttress must rise at least three times its span; to be really effective, it



Pierre Giraud, *Moyen Prompt, économique et sûr, de réparer à perpétuelle demeure les Piliers et les Colonnes engagées du Dôme du Panthéon français ...*, Paris: De l'Imprimerie des Sciences et Arts (s.a.), p. (1)

"Projet de Restauration du Panteon Français par P. Giraud Architecte du Palais de Justice. &c.", in: Pierre Giraud, *Moyen Prompt, économique et sûr, de réparer à perpétuelle demeure les Piliers et les Colonnes engagées du Dôme du Panthéon français ...*, Paris: De l'Imprimerie des Sciences et Arts (s.a.), plate s.n.

must be of a single piece. Even more problematical was his argument that as the abutment of a buttress was in the vertical plane, its thrust must be considered to act horizontally at this point. Gauthey pointed out, with specific reference to Gothic examples, that the thrust of a flying buttress lay on the line of its centre of gravity. This Rondelet was unable to grasp.⁴¹

Rondelet had, following Soufflot's example, referred to the extraordinarily slender columns of the Toussaint church at Angers and the columns of the Cluny chapel on the Place de la Sorbonne in Paris, when adducing the bearing loads of Gothic supports. Indeed he had illustrated these buildings first in 1808, in the third volume of *l'Art de bâtir*, but there was surprisingly little on Gothic construction in that compendious work. There is a brief reference to Gothic vaulting at the end of the third book and a few pages of instruction on the method of setting out ribbed vaults in the book following (both part of the second volume of *l'Art de bâtir*) illustrated on two plates. But this is all quite matter of fact. There is, as already noted, little more to recount of Gothic in *l'Art de bâtir*. The Gothic cathedrals of France referred

to in a footnote in Rondelet's final introduction, in support of his latter-day enthusiasm, make for a motley selection – Sainte Croix d'Orléans and the cathedrals of Chartres, Paris, Reims and Amiens, in that order.

There was nothing of surprise in Rondelet's final summation in the introduction. The intense discussions on the structure of Sainte-Geneviève had resulted, he thought, in renewed understanding:

“C'est à dater de ce moment, que l'on fut à même de pouvoir concilier les données de l'art avec celles de la théorie. Dès-lors, on en vint généralement à reconnaître que le but essentiel était, avant tout, de construire des édifices solides, en y employant une juste quantité de matériaux choisis et mis en œuvre avec art et économie.”⁴²

He ended with several familiar homilies, marginally rephrased:

“En effet, c'est le mérite de construction, qui constitue à tous les yeux le premier degré de beauté d'un édifice; et la perfection qu'il tient de l'art de bâtir, excite surtout notre admiration, par cela seul qu'elle devient le garant d'une plus longue durée. L'art de bâtir consiste dans une heureuse application des sciences exactes aux propriétés de la matière. La construction devient un art, lorsque les connaissances de la théorie unies à celles de la pratique préside également à toutes ses opérations.”⁴³

There are yet more of the familiar phrases. And more by way of theory can no doubt be teased out from the two thousand odd pages of *l'Art de bâtir*, though not much. Rondelet relied on repetition. Reduced to its simplest Rondelet's notion of theory remained from first to last that good construction is the essence of a good building. One wonders if Le Corbusier quite appreciated this point.

1 See Robin Middleton/Marie-Nöelle Baudouin-Matuszek, *Jean Rondelet. The architect as technician*, New Haven and London: Yale University Press 2007, p. 76 et seqq. Though Rondelet had considerable responsibility for the construction of Sainte-Geneviève, it was not until 1806 that he was appointed as architect, and the only elements in the building that he may be judged to have designed entirely himself were the colonnaded gallery above the stairs leading to the crypt, at the rear of the church, from 1806 to 1812, and the paving of the portico and the interior of the church, from 1808 to 1813. See id. pp. 182–188. Background information in this paper is to be found in this book.

- 2 Guillaume-Abel Blouet, *Traité théorique et pratique de l'art de bâtir de Jean Rondelet. Supplément*, V. I, Paris: Firmin Didot 1847, 1848, p. vi.
- 3 See Le Corbusier (Charles-Edouard Jeanneret), *Une maison – un palais*, Paris: G. Crès 1928, p. 190 et seqq. Le Corbusier himself refers to Sigfried Giedion's *Bauen in Frankreich. Bauen in Eisen. Bauen in Eisenbeton*, Leipzig and Berlin: Klinkhardt und Biermann 1928, p. 10. Giedion's indebtedness to Alfred Gotthold Meyer's *Eisenbauten: Ihre Geschichte und Aesthetik*, Esslingen: Paul Neff 1907, is noted in Sokratis Georgiadis' introduction to J. Duncan Berry's translation of this work, *Building in France. Building in iron. Building in Ferro-concrete*, Santa Monica: The Getty Centre for the History of Art and the Humanities 1995, p. 33, 69, 108. Meyer would seem to have misinterpreted Rondelet.
- 4 See Antonio Albertini "La biblioteca di Giuseppe Terragni", in: Giorgio Ciucci (Ed.), *Giuseppe Terragni. Opera completa*, Milan: Electa 1996, p. 88, 91.
- 5 = "I have always thought that the aim of architecture was to unite, in the most beautiful forms, and the most correct dimensions, all the parts requisite to the end for which one proposes to build, and to employ in their construction only a sufficient quantity of materials selected, and put to use with art and economy, in the shortest possible time.", in: Jean Rondelet, *Archives Nationales OI 1916 23*, covering letter and proposal reproduced in full in: Middleton/Baudouin-Matuszek, Jean Rondelet, op. cit. (see note 1), Appendix three, p. 307.
- 6 Jean Rondelet, *Mémoire sur l'architecture*, Lyon: Bibliothèque municipale, July 3, 1786, 30 unnumbered pages and Jean Rondelet, *Mémoire sur l'architecture*, Lyon: Bibliothèque municipale. July 3, 1786b, 7 unnumbered pages, – see Middleton/Baudouin-Matuszek, Jean Rondelet, op. cit. (see note 1), p. 139.
- 7 = "The aim of architecture is, in general, to construct convenient and sound buildings that unite in the most beautiful forms and the most correct dimensions all the parts requisite to the end for which one proposes to build. To attain this end architects divide their art into three main parts, which are: Planning, Construction and Decoration."
- 8 = "Since the revival of greek architecture, architects have been too concerned with decoration, they have made of this part, which is but an accessory, a principal aim; this abuse arose from when gothic architecture was abandoned, the leading architects being no more than painters or designers who were interested only in decoration, because they no longer found to their liking the other two parts, which required a knowledge of the art and the use for which buildings are intended. For this reason their products were, for the most part, no more than decorated masses, which had no relation to planning and construction, resulting in a clumsy and wasteful architecture where all was subject to the whim of the decorator."
- 9 = "Most of our architects being decorators rather than constructors, scarcely understand the skills required to execute their designs."
- 10 Jean Rondelet, *Mémoire*, op. cit. (see note 6), p. 5: "Le but essentiel de l'Architecture, est en general de construire des édifices commodes et solides, qui réunissent sous les plus belles formes, et les plus justes dimensions, toutes les parties nécessaires à l'objet pour lequel on se propose de bâtir."
- 11 = "Architecture is by contrast an art that is essentially useful, which requires much knowledge, prudence, and skill to unite in a single building beauty, convenience, soundness and economy.", in: id., p. 11.
- 12 See Middleton/Baudouin-Matuszek, Jean Rondelet, op. cit. (see note 1), p. 144.
- 13 = "The *art of building* is distinct from architecture and from the science of construction. The *art of building* was born of need: the art of architecture emerged from pleasure. The science of building emerged from both of them, and from the application of the sciences of calculation.", in: Antoine Chrysostôme Quatremère de Quincy, *Encyclopédie méthodique. Architecture ...*, V.I, Paris: Panckoucke 1788, p. 250.

- 14 = "The *art of building* of the Gothics required much skill and intelligence. The architects of the twelfth century managed, with an astonishing sagacity, to distinguish the principal parts of their buildings that constitute, so to speak, their *skeleton*, from the intermediate parts that are the infill. For the *skeleton*, they used dressed stones, whose strength and resistance alone were sufficient to ensure the strength of their buildings, owing to the height, lightness, and separation of the points of support. But they used rubble as infill and as *lighteners*, everywhere solid mass was unnecessary. By this means, they managed fully to unite strength and economy in their buildings. There is no excess in them, nothing that is useless, and not an essential part of the whole.", in: id., p. 253.
- 15 = "The interiors of beautiful gothic churches, such as the one in Amiens, present an aspect that is grander, nobler, more *unified* and more varied than most of our modern churches, built with arcades and decorated with an architectural order.", in: id., p. 254.
- 16 = "To examine what advances have been made, by different peoples, in the part of architecture known as *the science of the construction of buildings*, from the earliest times to our own day."
- 17 Printed programme and manuscript essay, "Mémoire sur le progrès de la science de la construction chez les différens peuples, prix remporté à l'Institut", New York: Avery Library, Columbia University.
- 18 = "It is a matter of examining the advances made in what is better known as theory. This is the result of reasoning and experiment, subject to the principles of physics and mathematics. A skilled builder who has fully mastered theory can justify all the means that he proposes to give a building, all the strength and perfection of which it is capable, by using the most appropriate materials, used with skill and economy; and as one can reason correctly and consequently only about those things that one knows in depth, it follows that a good builder must combine a knowledge of physics and mathematics with the different procedures used by the ancients and the moderns, and that he should also be familiar with the nature and properties of materials so as to be able to determine with certainty, the forms, the dimensions, and all the precautions necessary for constructing sound and durable buildings.", in: Rondelet, *Mémoire*, op. cit. (see note 6), p. 9.
- 19 = "They managed by this means to unite strength and economy in their buildings: in those that are admired one finds nothing excessive, nothing that is without purpose and is not an essential part of the whole.", in: id., p. 83.
- 20 = "Where reigns a unity of the whole that stirs admiration.", in: id., p. 84.
- 21 = "They managed by this means to unite strength and economy in their buildings: in those that are admired one finds nothing excessive, nothing that is without purpose and is not an essential part of the whole.", in: id., p. 90.
- 22 = "The essential aim of architecture is to construct convenient and solid buildings that unite, in the most beautiful forms and the most correct dimensions, all the parts requisite to the end for which one proposes to build. To achieve this aim, architecture is divided into three principal parts, planning, decoration and construction.", in: *Prospectus d'un traité théorique et pratique sur l'art de bâtir, par le citoyen Rondelet, architecte et membre du Conseil des Bâtimens civils auprès du Ministre de l'Intérieur*, (16 Pages), Centre Canadien d'Architecture, Cagé 7192, p. 2.
- 23 = "The essential aim of the art of building is to construct sound buildings, by employing the correct amount of materials selected and employed with skill and economy. The art comprises two main parts, which are *theory* and *practice*; the perfection of the art of building depends on uniting these two parts. Practice, which is the oldest, is the art of extracting materials, transporting them, preparing and shaping them for the execution of any work whatever. Theory is the science that controls the procedures of practice. This science is the result of experiment and reasoning,

based on the principles of mathematics and physics applied to the various operations of the art. It is by means of theory that a skilled builder manages to decide the shape and the correct dimensions that must be given to each part of a building, depending on its position and the loads it might have to bear, such that the result will be perfection, soundness and economy.”, in: Jean Rondelet, *Traité théorique et pratique de l'art de bâtir*, I, Paris: l'auteur 1802, part 1, p. v.

- 24 = “Architecture is a science whose essential aim is to construct sound and convenient buildings that unite, in the most beautiful forms, all the parts requisite to their purpose.”, in: Rondelet, *Traité théorique*, op. cit. (see note 23), V. I, part 1, 1802, p. 7.
- 25 = “Architecture is a science comprised of several precepts and various sorts of knowledge, by means of which it can evaluate the works of the other arts that it guides; this science is the result of practice and theory. Practice is the aim of the manual operations required to give to material the form that it ought to have, for whatever kind of work. Theory is the science that can explain and demonstrate the procedures and the correctness of the proportions of the work completed...”, in: Rondelet, *Traité théorique*, op. cit. (see note 23), V. III, 1805, p. 2. It is of some interest to compare this passage and the translation offered with that in the recent translation, in: *Vitruvius. Ten books on architecture*, transl. by Ingrid D. Rowland, Cambridge: Cambridge University Press 1999, p. 21 – “The architect’s expertise is enhanced by many disciplines and various sorts of specialized knowledge; all the works executed using these other skills are evaluated by his seasoned judgement. This expertise is born both of practice and reasoning. Practice is the constant, repeated exercise of the hands by which the work is brought to completion in whatever medium is required for the proposed design. Reasoning, however, is what can demonstrate and explain the proportions of completed works skillfully and systematically.”
- 26 = “We will be concerned in this treatise only with theory that relates to construction. The aim of this essential part of the art of building is to analyse the elements of a building in relation to strength, to investigate the methods of execution and of economy, in relation to different materials, their nature, their properties and the manner in which they are to be employed.”, in: Rondelet, *Traité théorique*, op. cit. (see note 23), V. III, 1805, p. 5.
- 27 = “Architecture is not, like painting and sculpture, an art whose sole aim is to please, in which the artist, executing his work himself, can give way to the fire of his imagination; it is a science, the essential aim of which is to construct sound and comfortable buildings, which unite in the most beautiful forms all the parts required for their purpose.”, in: Jean Rondelet, *Discours pour l'ouverture du cours de construction et de stéréotomie*, Paris [1806], p. 8.
- 28 = “We have already said that the essential aim of the art of building is to erect sound buildings, using the correct quantity of materials selected and applied with skill and economy.”, in: Rondelet, *Discours*, op. cit. (see note 27), p. 9. Le Corbusier quoted this same sentence, preceding it with another from p. 6 – “Une des principales causes qui rendent notre manière de bâtir si coûteuse, est l'inexpérience de ceux qui ont négligé l'étude de la construction, pour se livrer, exclusivement, à la décoration.”, in: Le Corbusier, *Une maison – un palais*, op. cit. (see note 3), p. 191.
- 29 = “Architecture is not, like painting and sculpture, an art whose sole purpose is to please, and in which the artist, executing his work himself, can surrender to the full fire of his imagination; it is a science whose essential aim should be to construct sound buildings that unite, in the most beautiful forms and with the correct dimensions, all the parts requisite for their purpose...”, in: “Note présentée à la section d'architecture par M. Rondelet, Professeur de Construction, sur la lettre adressée le 24 Aout 1819 par S. Excellence le Ministre Secrétaire d'Etat de l'Intérieur à M. le Président de l'Ecole royale et spéciale”, BHVP CP 3469, p. 3 (unnumbered).
- 30 *Prospectus d'un traité théorique et pratique de l'art de bâtir. Nouvelle édition, revue par l'auteur et divisée en dix livres, formant 5 volumes*, (Paris 1827), 16 pages, BnF. Vp 3006.

- 31 *Traité théorique et pratique de l'art de bâtir par Jean Rondelet. Prospectus de la sixième édition, revue par l'auteur, et divisée en dix livres; cinq volumes in 4^o*, Paris 1830. – subscriptions were to be taken “Chez M.A. Rondelet fils, architecte, éditeur des œuvres de son père, à Paris, Place Sainte-Genève, vis-à-vis l'École de Droit”.
- 32 = “Independent of the richness of the soil in materials suitable for building, this art comes closest to its perfection, there, where reasoning rather than simple practice rules over its first arrangements.”, in: Rondelet, *Traité*, op. cit. (see note 23), 5th. edition, vol. I, 1827, p. i; 6th. edition, vol. I, 1830, p. iv.
- 33 = “Too judicious to be wholly blind to the false path they had taken, one finds them trying to conceal, by means of art, the shocking contradictions presented, at every moment, by this strange metamorphosis.”, in: id., 5th. edition, vol. I, 1827, p. iii; 6th. edition, vol. I, 1830, p. vi, with “trop judicieux” substituted for “judicieux”, “entièrement” introduced, and “qu'ils prenaient” instead of “dans laquelle ils venaient de s'engager”.
- 34 = “Architecture never perhaps produced anything comparable, and, to speak only of its merit as it relates to the art of building, what an immensity of covered space! what astonishing correctness of proportion between the walls, the points of support and the vaults! and at the same time a guarantee of duration which seems to have no end but that of the material itself.”, in: id., 5th. edition, vol. I, 1827, p. vi; 6th. edition, vol. I, 1830, p. xiv.
- 35 = “Before the period of the regeneration of the arts in the centre of Italy, the peoples furthest from Rome, having no need to refer to the works of their predecessors, involved moreover with their own activities, managed to create an architecture. Here, as in Egypt, this art presents, from its beginning, a system of construction on which all its compositions would be based; again, as in Egypt, it demonstrates a preoccupation to ensure the greatest duration for its works; but instead of masses laboriously stacked, as with this last people, the art of building usually operated with materials that the Egyptians would have rejected; and guided only by practical mechanics, it attained step by step to the most extraordinary results.”, in: id., 5th. edition, vol. I, 1827, p. viii; 6th. edition, vol. I, 1830, p. xviii.
- 36 “If this praise of gothic requires justification, it is enough to recall how, by means of forms and arrangements, the material alone, through the dual force of its weight and its strength, manages to make up the most stable of wholes, independent of the joining properties of cement, which is of little help in dressed stone construction; how, in addition, by clever arrangements, perishable materials are made to last; how, finally, in the midst of a system where everything is active, nothing seems to tire the eye, neither in the whole nor in the parts.”, in: id., 5th. edition, vol. I, 1827, p. viii; 6th. edition, vol. I, 1830, p. xx, with “S'il était besoin de” instead of “pour” and “suffirait” instead of “suffira”.
- 37 = “One cannot help but regret to see a system of construction so suited to the resources and the nature of our climate, which might be suitable still in so many instances, entirely abandoned in our time.”, in: id., 5th. edition, vol. I, 1827, p. viii; 6th. edition, vol. I, 1830, p. xx, with “s'empêcher de” added.
- 38 = “The principle aim of M. Soufflot in erecting his church was to unite in the most beautiful of forms the lightness of gothic construction with the purity and magnificence of greek architecture.”, in: Middleton/Baudouin-Matuszek, Jean Rondelet, op. cit. (see note 1), Appendix two, p. 302.
- 39 See Henry Ronot, “L'église de Notre-Dame de Châteauvillain”, in: *Annales de la Société d'histoire, d'archéologie et des beaux-arts de Chaumont*, V. VI (1935), n. 5, p. 126 et seqq.
- 40 See Middleton/Baudouin-Matuszek, Jean Rondelet, op. cit. (see note 1), pp. 89–93.
- 41 Id., Chapter eight, in particular p. 162 et seqq.

= “From this moment forward it became possible to reconcile the fundamentals of art with those of theory. From then it was generally recognized that the essential aim was, above all, to construct sound buildings, using the correct quantities of material chosen and employed with skill and economy.”, in: Rondelet, *Traité*, op. cit. (see note 23), 5th. edition, vol. I, 1827, p. xi; 6th. edition, vol. I, 1830, p. xxvi, with “pouvoir concilier” instead of “combiner ensemble” and “Dès-lors” instead of “Enfin”.

= “In effect, the merit of construction, which in everyone’s eyes constitutes the first degree of beauty in a building; and the perfection it partakes in the art of building, particularly stirs our admiration, if only because it is a guarantee of long lasting. The art of building consists in the apt application of the exact sciences to the properties of materials. Construction becomes an art when knowledge of theory united to that of practice presides equally over all its operations.”, in: id., 5th. edition, vol. I, 1827, p. xi; 6th. edition, vol. I, 1830, p. xxvi, with “excite surtout” instead of “en excitant” and “par cela seul qu’elle devient le garant d’une plus longue durée” instead of “présente en même temps un garant de sa durée”.