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On Material Knowing in Architecture**

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Transformative Dialogues: On Material Knowing in Architecture

Eireen Schreurs

Labrouste was the first who understood the advantages of the use of iron, not as a framework, hidden in old forms, but as a new means of construction that could be frankly revealed in a new form.¹

M. Rapine, architect, 1910

In 1857, the architect Henri Labrouste set himself to the task of designing the new *Bibliothèque Impériale* (later *Nationale*) in Paris. Already at the very start of the project, Labrouste had decided on an iron construction for its interior. That in itself was not an extraordinary choice, since from the mid-nineteenth century, iron had rapidly become widespread in the French construction industry, promoted for its affordability and incombustibility. His decision to keep the material visible and let the properties of iron guide his design does point to a specific awareness of the material. At the time, exposed iron constructions were restricted to infrastructural works and commercial buildings, and never visibly used in representational buildings for the state or cultural institutions. The material of choice for these projects had thus far been stone, whose properties had determined the architectural language for monumental buildings. Although classically trained at the Beaux-Arts and a state architect, Labrouste was somehow able to work his way past these conventions, letting iron determine the interior of an important national institute.² This essay explores in more detail the interaction between architect and material, using the case study of Labrouste to get a better understanding of the idea of material knowledge and its role in the design process.

Defining material knowledge

Before we turn to the Bibliothèque Nationale, we need to identify ideas of material knowing in the existing definitions of design knowledge. In an influential article from 1982, design theorist Nigel Cross describes ‘designerly ways of knowing’ as a form of embodied knowledge. In his definition of design, material knowledge is included as ‘the collected experience of the material culture, and the collected body of experience, skill and understanding embodied in the arts of planning, inventing, making and doing’.³ Cross understands material culture as a body of non-verbal codes, and every act of design as a manipulation of these codes. It is important to keep in mind that Cross’s definition aimed to emancipate design thinking within academia, which was dominated by modes of thinking developed in the sciences and humanities. To demonstrate its value for the academic world, Cross described design as a form of conceptual problem-solving more than relating it to architectural practice or the sensorial experience of the built result. Certainly, buildings contain knowledge in their representation of cultural contexts, but they are also physical entities, manufactured at some point and composed of matter with specific properties. The building process itself is the moment when a design becomes a physical reality and where material understanding is crucial for a successful result.

Recent insights in other academic fields might be able to fill that lack of focus in Cross’s definition and help to investigate the role of material knowledge. In the humanities, the so-called ‘material turn’ has put the role of materials centre stage, leading to new modes of thought.⁴ Before, materials were seen as facilitators, ‘afforders’ at the most, but recent theories in these fields identify the character and agency of the material itself, acting in correspondence with the maker.⁵ Art historian Ann-Sophie Lehmann also considers material knowledge in art as a dialogue between material and artist.⁶ The study of the pedagogical ideas on material handling, developed by Bauhaus educator Moholy-Nagy, led her to coin the term ‘material literacy’, as ‘a broad sensitivity to materials and their diverse meanings’.⁷

Relevant here is Lehmann’s priority given to the idea of sensitivity.⁸ Whereas Cross emphasizes the social and cultural knowledge residing in material objects, Lehmann stresses the importance of a sensorial or

bodily relation to materials. She adds the adjective ‘broad’ with a double meaning and intent. For her, material literacy is a form of general knowledge, to be distinguished from the highly specific technical knowing and experience of, for example, the craftsman or the scientist. The ‘broad’ in her definition also refers to the responsibility of the designer to include a social (and environmental) awareness in their material handling.⁹ A last remark concerns the combination of the words ‘material’ and ‘literacy’, stressing the dialogue between the maker’s knowledge and the material properties, the artist depending on the materials and their modes of action.¹⁰

We can conclude that material knowledge in design and the arts forms a constellation of rational and tacit forms of knowledge. Combined with the scientific knowledge of material performance, this includes Cross’s cultural notion of material and Lehmann’s more skill- and sensitivity-based knowledge. In the next step, we return to the architect and the architectural project – the case of Labrouste’s Bibliothèque Nationale – to see material knowledge in action.¹¹ How do the rational and more intuitive forms of material knowledge balance each other? How does the architect acquire this material knowledge? And lastly, how do materials inform and instigate the design project and shape the material knowing of the architect?

Material dialogues: Labrouste and iron

Henri Labrouste’s first proposal for the Bibliothèque’s reading room interior was not an act of genius but rather one of imitation (Fig. 1). He drew a domed room with a central rooflight, following the scheme of architect Smirke’s recently completed London Library, with iron beams integrated into the ceiling, faintly visible but not in an outspoken way.¹² But at another point in the design, iron played a more prominent role. Apart from the reading room, a large archive space also had to be fitted into an existing courtyard, requiring an efficient use of space (Fig. 2). For these archives, Labrouste proposed a compact iron structure that cleverly included a bookcase system and contained slatted iron floors, enabling a maximized storage space of seven floors while allowing for light to enter deep into the building. The integrated application of iron demonstrated

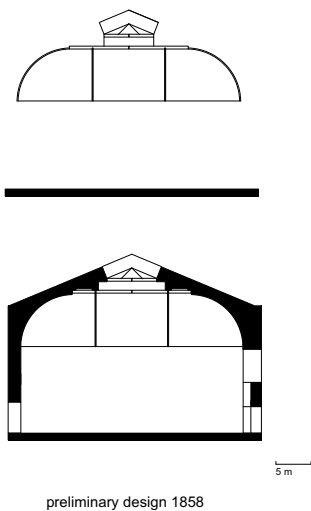
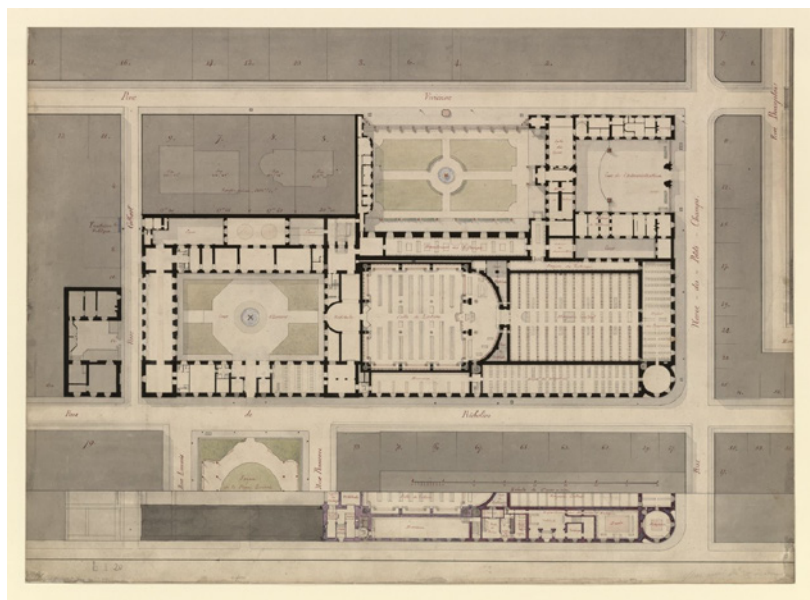


Fig. 1. First design proposal, 1858: the reading room with single oculus and hidden iron beams (drawing Eireen Schreurs).



Source gallica.bnf.fr / Bibliothèque nationale de France

Fig. 2. Bibliothèque Impériale Plan d'Ensemble, 1869 (office Henri Labrouste).

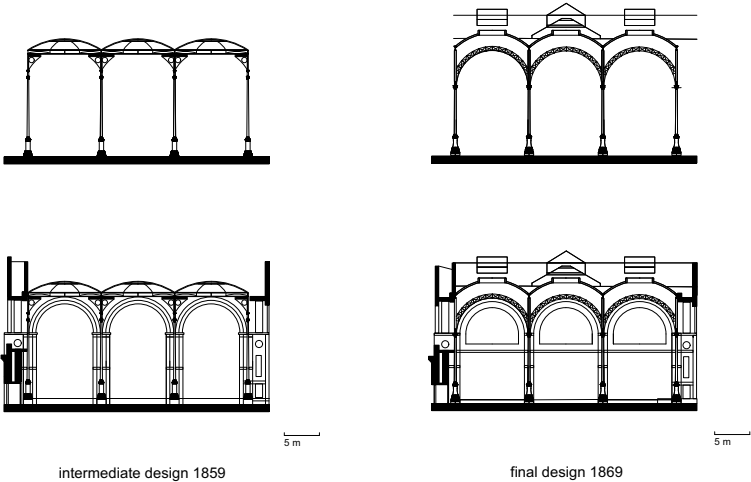


Fig. 3. Second design proposal, 1859: with flat roof and slightly bulging rooflights (drawing Eireen Schreurs).

Fig. 4. Reading room as executed with nine oculi and iron arches (drawing Eireen Schreurs).

Labrouste's technical understanding of the material, but the chosen solution also showed that Labrouste was able to visualize the atmospheric potential of the material. In Smirke's archive for the London Library, a similar structural system had been used, but here the archive space had been kept invisible for the visitors. Labrouste did exactly the opposite; in the design, he drew an enormous window linking the archive with the public reading room, putting the iron on full display, as an intricate Piranesian drawing.¹³

In the next design step, Labrouste returned to the structure of the reading room, reacting to the comments of colleague architect Felix Duban, who observed that the single rooflight of the dome could cause the readers' shadows to fall on their books. Labrouste changed the dome into a flat roof containing nine rooflights supported by a grid of iron beams (Fig. 3).¹⁴ Labrouste placed iron columns under every knot of the grid, like a table with sixteen legs, with four freestanding columns, within the perimeter of a solid stone wall. The development of the roof marks a moment where the material enabled Labrouste to make a choice that would radically alter the character of the interior. Iron could have spanned the

space in one go, but its compressive strength afforded the alternative of multiple columns that were so slender they almost disappeared.¹⁵ The adage of Labrouste was that *'every material had to find its own form'*. The decision to put four columns in the middle of the room was an unprecedented move and a follow-up on his experiments with iron in an earlier project: the Bibliothèque Sainte Geneviève. It was Labrouste's recognition of iron's elegance that provided an alternative to the solid monumentality of the stone encasing of the room, even if it meant transgressing existing cultural conventions.

The reading room interior was now defined by the stark contrast of the massive stone walls to the slim iron construction. In consecutive steps, Labrouste worked to again soften this opposition by shaping the iron to mimic the stone, seeking resemblance in form and detailing. Labrouste changed the reading room roof a second time. He copied the arched forms of the perimeter stone wall to the iron structure, so that the iron roof bulged into nine cupolas (Fig. 4). Also, in the ornamentation of the pedestals, the iron columns started to bear a strong formal resemblance to their stone counterparts. This might seem strange, but not so much if you understand the realities of construction in those days. The process of casting required a wooden mould that was chiselled by the *artisan-sculpteur* Perrin, the same craftsman who executed some of the stone- and woodwork of the reading room interior.¹⁶ Did Labrouste's 'to every material its own form' not apply to the detailing? Did his material knowledge end here, having the craftsman taking over? It is more complicated than that. The iron columns were classical in form and detail, but Labrouste must have been aware of their surreal appearance: the shafts were uncannily thin and the tiny Corinthian capitals almost seemed to ridicule the classical stone orders. The profiles of the iron pedestals were just a bit sharper, bending slightly downward, as if Labrouste wanted to acknowledge iron's liquid character.¹⁷ The details show a play with the cultural codes and suggest that his search for a proper representation of iron was aided by an artisanal understanding of the processes of making. The reconciliation of iron's radically different character with the classical canon was also enabled by Labrouste's personal style, characterized by elegance and refinement, which was recognizable in all his architectural work, up to his handwriting and the miniature sketches in his many black notebooks.

How architects sense materials

What the design process of the Bibliothèque reveals is that varied forms of material knowing were in operation within every step of the design. But what also becomes apparent is how, at crucial moments, Labrouste's intuitive sensitivity for the material enabled him to steer the project away from conventional solutions towards innovation and the creation of new experiences. This calls to mind the distinction posed by philosopher Gilbert Ryle between 'knowing that and knowing how'; technical and cultural knowledge do not suffice to act, rather an architect can only make knowledge productive through a more intuitive 'knowing how'. This does raise the question of how architects are able to acquire this material sensitivity. Unlike the craftsman or artist, the architect never handles the material himself and, as a consequence, lacks the experience of its resistance. It is true that architects make decisions when the project is only on paper. At some point, however, any designer faces the consequences of his design in the reality of the project. This renders material experience into a process of continuous evaluation, a feedback loop, allowing the designer to test issues such as scale, proportion, textures, material combinations, etc. over the course of several projects. Apparently, this material experience can be *imagined*, the architect building upon existing knowledge and experience. This is why in the Bauhaus *Materialkurz*, Moholy-Nagy included *handwerk*. It not only trained the senses, such as vision, sound and tactility but also sharpened the technique of imagining.

Labrouste could visualize the material reality of the iron construction in his archive, seeing it so vividly that he imagined a large window to go with it, at a moment when the design was only a first idea. His visit to Smirke's archive with the attractive filigree structure, dramatically skylit, must have made a lasting impression, enabling him to mentally transplant this idea to his own building. The sketchbook of his visit to London does not contain sketches of Smirke's reading room; it only shows precise details of the archive structure, demonstrating that he recognized the potential of iron straight away, waiting for a fit moment to apply it. Indeed, Labrouste probably never processed iron himself, but he must have seen others doing so, often. Labrouste instructed the mould maker of the iron columns, paying visits to the atelier. And for the duration of the construction, a temporary office-annexe was located right next to the construction

site, giving him the sounds, smells and slow progress of the building as a multi-sensorial feedback.

And Labrouste used the tool of drawing. According to anthropologist Tim Ingold, in drawing, you can become the object that you draw. It is a tool for sensitizing, the drawing tracing the object as ‘an archive of its maker’s muscles’.¹⁸ The draughtsman can reach a certain form of direct experience by rebuilding the design with the eye. As a *Prix de Rome* laureate, Labrouste had spent an impressive five years in Italy redrawing the buildings from the Roman times and the Renaissance, which had made him an outstanding draughtsman. His drawings of the period can be interpreted as detailed investigations into various materials, for which he applied different techniques. The more atmospheric sketches and water-colour drawings allowed him to ‘feel’ the material and trace its textures, irregularities, treatment and weathering. The architectural, measured drawings offered him the possibility to understand materials from their structural logic and build-up.¹⁹ Later, Labrouste also filled many sketch-books, revealing a continuous recording and testing of ideas in very delicate drawings, the books often not larger than a business card.



Fig 5. Interior of the *Salle de Travail* or reading room at the inauguration, as published in *Le Monde*, 1868 (drawing B.Y. Linton).

How materials innovate

So then, lastly, what is the role of the material itself in the production of material knowledge? The TACK network is founded on the idea that tacit knowledge holds the specific capacity to respond to change.²⁰ In the case of material knowing, we have seen that material change instigates a design response; it arouses the interest of the designer and tickles the imagination. In his book *The Craftsman*, Richard Sennett describes how the craftsman is aware of material forces through his or her 'material consciousness'.²¹ This consciousness is sharpened by the 'alchemical translation of materials into architecture'. That Semper was equally fascinated by material change and its potential to innovate can be inferred from his idea of *Stoffwechsel*, a phenomenon whereby existing forms are renewed through the introduction of new materials.²²

How this process of material change operates in the design process can be seen if we return to Labrouste once more. The dialogue between stone and iron became the prime generator of the reading room, allowing Labrouste to use the codes of stone as providers of meaning while at the same time transforming them. The material reality of iron allowed Labrouste to dismantle the premises on which classical architecture was built. The dialogue between the wall and the iron structure that had started from a constructional logic also fuelled its detailing. Labrouste proposed an architecture of light and refinement, dramatizing the contrast between the different origins of the materials: the earthy, massive materiality of the stone versus the fluid formlessness of iron. In doing so, the iron column bases could start to be read as iron weights, keeping the elegant roof structure from flying away. (Fig. 5) Out of an innovative sensitivity to the properties of iron, a dematerialized architecture arose, predicting what would become a prime concern of modern architecture.²³

To close

This article is a first dig into the idea of material knowing, revealing how material sensitivity operates as a decisive driving force in the creative process. The moment an architectural idea has to be transformed into a physical construct, the material sensitivity brings scales, materials

and spatial effects together, laying relations, opposing, reconciling or simply creating aesthetic delight. Sensitivity is also a dominant mode of thinking in moments when the design starts to operate beyond material conventions, beyond facts and technical constraints, forcing the creation of something that did not exist before: a material culture yet unknown. Architects acquire this aspect of material knowing through a personal preference for certain materials, which can be traced back to their biography and earlier work, ultimately resulting in an oeuvre where ideological, stylistic and material preferences merge. Is it a coincidence that the refinement of Labrouste's handwriting and drawing is also visible in his architectural style and that this quest for elegance bound him for life to the material that could provide him with the means to create it?

The unique conditions of architecture, as a social, cultural, political and aesthetic project, feed the creative knowing of the architect, who seeks to translate these conditions into a form and material that are meaningful or even create new meanings. With the Bibliothèque, Labrouste constructed both an intimate and transparent palace for knowledge. In order to open the building up to all who sought knowledge, he used a construction that was associated with more mundane programmes, lowering the library's threshold while creating optimal reading conditions.²⁴ Material knowledge concentrates the overwhelming complexity of the assignment into a simple column in the centre of the room and with this single gesture, gives iron a new form and future.

Notes

- 1 'Labrouste, le premier, comprit tout le parti que l'on pouvait tirer de l'emploi du fer, non comme une ossature à cacher sous les formes anciennes, mais comme un nouveau moyen de construction devant rester franchement accusé par des formes nouvelles.' M. Lapine was an architect and chef of the historical monuments department. *Souvenirs d'Henri Labrouste, architecte, membre d'institute: notes recueillies et classées par ses enfants et ses élèves* (Fontainebleau: Cuénot, 1928), 67.
- 2 Bertrand Lemoine, 'Labrouste and Iron', in: Corinne Belier, Barry Bergdoll and Marc Le Coeur (eds.), *Henri Labrouste: Structure Brought to Light* (New York: The Museum of Modern Art, New York, 2013), 181.
- 3 Nigel Cross, 'Designerly Ways of Knowing', *Design Issues* 3:4 (October 1982), 221.
- 4 As Tim Ingold and Jane Bennett (amongst others) have remarked, the hylomorphic model, or the primacy of idea over matter, has been the dominant mode of thinking throughout modernity. Jane Bennett, *Vibrant Matter, A Political Ecology of Things* (Durham: Duke University Press, 2010), 56.

- 5 Ann-Sophie Lehmann, 'The Matter of the Medium. Some Tools for an Art Theoretical Interpretation of Materials', in: Christy Anderson, Anne Dunlop and Pamela H. Smith (eds.), *The Matter of Art: Materials, Technologies, Meanings 1200–1700* (Manchester: Manchester University Press, 2015), 21–41.
- 6 Lehmann, 'The Matter of the Medium'.
- 7 Ann-Sophie Lehmann, 'Material Literacy', *Zeitschrift Bauhaus* 9 (2017), 20–27.
- 8 Laszlo Moholy-Nagy, *The New Vision 1928 and Abstract of an Artist* (New York: Wittenborn Schultz Inc., 1947), 17.
- 9 Literacy is, according to the Oxford dictionary: 1. To read and write 2. Having education or knowledge typically in a specified area. Nigel Cross describes designers as 'having the ability to both read and write: they understand what messages objects communicate, and they can create new objects which embody new messages'. Cross, 'Designerly Ways of Knowing', 225.
- 10 The term 'literate' translates into German as 'gebildet', a term that translates itself back again as 'educated'.
- 11 The Labrouste archives on the building are extensive (700 pieces) but by no means complete. This article is based on an initial study of the archives at the Bibliothèque Nationale de France (BnF) and the Labrouste sketchbooks at the Académie d'Architecture, in 2019 and 2020.
- 12 Many buildings at the time in Paris had hidden iron ceiling structures, though cupolas were rare. One famous and much older example is the Halles aux Blés (1811), which was covered with an iron roof containing an oculus.
- 13 Henri's brother and colleague Theodore had copied the work of Piranesi, stripping it of its baroque details, putting more emphasis on structure and light. Francisco Javier Girón Sierra, 'Understanding Roman Construction Before A. Choisy: Piranesi and his Influence on Rondelet', in: James W.P. Campbell et al., *Studies in the History of Construction, Second Conference of the Construction History Society* (Cambridge: Construction History Society, 2015), 11–21. Labrouste's alternative, more radical option contained even vaster glass panels between the archive and reading room. Neil Levine, 'Paths Not Taken: Little-known Projects by Henri Labrouste for the Bibliothèque Nationale' (conference BNF Richelieu 'Un projet en question', Institut National d'Histoire de l'Art, 5–6 July 2010).
- 14 The section described here resembles the final design, but the flat ceiling, the absence of the iron cupolas and the iron triangular stability angles demonstrate that this is an earlier version, not described in the existing literature.
- 15 Freestanding columns did not make a first appearance in this project. His earlier Ste Geneviève Library had iron columns as well, but they stood in a row, as in train stations of the time. The non-directional grid of the proposal not only avoided an association with infrastructural works but also introduced a more informal non-hierarchy in the reading room. David van Zanten, 'Marble's Translucence and What Mid-nineteenth Century Architects Made of It', symposium 'Marble', Florence, 2010.
- 16 There are different sources for the name of the sculptor. Pierre Saddy mentions Lorrain, but without providing a source. The *Archive Nationale* file F21/2915A mentions a payment on 31.05.64 to Auguste Perrin for making the models for the columns. In F21/2915B the same Perrin was paid for wooden and stone ornaments.
- 17 Labrouste sketched the iron and stone columns next to each other, ending in profiles that were much more alike than in the beginning. From the school textbook of Pierre Chabat, *Fragments d'Architecture; Egypte, Grèce, Rome, Moyen age; Renaissance, age moderne, etc; avec notices descriptives* (Paris: Morel, 1868), plate 56. That the difference between iron and stone detailing was considered relevant in his time is demonstrated by the fact that the iron and stone pedestals were printed next to each other.

- 18 James Elkins, quoted in Tim Ingold, 'The Textility of Making', *Cambridge Journal of Economics* 34:1 (2010), 99.
- 19 Labrouste caused quite a scandal with his infamous Paestum drawings, of which the argument for an alternative dating of the Paestum temples was based on a precise observation of the buildings as material objects. Martin Bressani, 'The Paestum Controversy', in: Corinne Beliel, Barry Bergdoll and Marc Le Coeur (eds.), *Henri Labrouste, Structure Brought to Light* (New York: The Museum of Modern Art, 2013), 88–93.
- 20 ERC-funded training network 'Communities of Tacit Knowledge: Architecture and its Ways of Knowing' (2019–2023, project no. 860413).
- 21 Richard Sennett, *The Craftsman*, (London: Penguin Books, 2008), 120–144.
- 22 Akos Moravánszky, *Metamorphism, Material Change in Architecture* (Basel: Birkhäuser, 2017), 15.
- 23 That this was by no means self-evident, becomes clear when Semper writes in 'Style' that it is not possible to speak of monumental iron or cast-iron style for 'their ideal is invisible architecture'. Moravánszky, *Metamorphism*, 242.
- 24 The reading room was public but not for everyone. The library had a problem of homeless people seeking shelter before the refurbishment and, therefore, Labrouste created a *salle de lecture* for the general public in the old building, while the *salle de travail* was reserved for accredited researchers. Corinne Beliel, Barry Bergdoll and Marc Le Coeur, (eds.), *Henri Labrouste, Structure Brought to Light* (New York: Museum of Modern Art, New York, 2013), 176.

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