Epistemic Horizons: Embracing Tacit Understanding and Generative Potential in the Appraisal of Knowledge

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Abstract
This article explores the appraisal of knowledge in architecture and its role in shaping architectural thought, design and production. Building on Michael Polanyi's concept of tacit knowledge – knowing more than we can tell – the article proposes to address the challenge of assessing such knowledge by the appraisal of its generative potential. I argue that tacit knowledge can be valued by the possibilities it creates within specific social and material environments. Through an interdisciplinary approach, incorporating insights from cognitive psychology, anthropology and information theory, three modes of comprehension are identified – correspondence, adaptation and poetic. Emphasising the interplay of knowledge, cognition, and imagination, I propose that knowledge should be appraised based on its generative potential, rather than merely codified information. Architectural knowledge, exemplified in the work of Eduard van Steenbergen, is evaluated from a capacity to 'objectify abstract space' – that is, by how it gives substance to spatial ideas, notions and qualities – and manipulate spatial relations, integrating skill, knowledge and agency. Opening up new avenues for epistemological inquiry within architectural research, I invite scholars to reconsider their approaches to knowledge appraisal and to embrace a broader, yet more precise understanding of knowledge production in the discipline.

Keywords
Epistemology, tacit knowledge, architectural knowledge

One Sentence Summary
Drawing from a reflection on the methodology of knowledge appraisal, this article suggests that architectural knowledge can be understood as a capacity to materialise abstract spatial relations into meaningful representations.

An important question in any piece of architectural research is how its outcomes can be beneficial to architectural thought, design and production. This question exposes the underlying problem of how knowledge can be recognised and valued, an endeavour that is especially challenging in regard to tacit ways of knowing. First described as such by Hungarian chemist and philosopher Michael Polanyi, tacit knowledge is the form of knowing that is not or cannot be made explicit. It is the knowledge reflected in the fact that 'we know more than we can tell'.[1] Appraisal of this form of knowledge is complex because its justification – a fundamental requirement for the appraisal of knowledge in classical epistemological studies – is not straightforward. This article addresses the problem of how tacit knowledge can be accessed and tested. It develops the hypothesis that tacit knowledge can be appraised by focusing on

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what it makes possible in a particular social and material environment.

To construct this interpretation, I first confront classical propositions of epistemology and information theory when confronted with the question of knowledge appraisal. In contrast to the modes of assessment based on information theory, I argue that knowledge, cognition and imagination are interdependent and can only be appraised in conjunction. Developing this argument, I examine the process of knowledge acquisition, focusing on the interplay between information-processing and the formation of knowledge, and outlining three distinct modes of comprehension: correspondence, adaptation and poetic. The first mode, correspondence, reflects a utilitarian approach to knowledge acquisition, characterised by analytical reasoning and pattern recognition. The second mode, adaptation, enables the integration of novel insights and the refinement of existing knowledge structures. Finally, I expose the importance of imagination as a foundational element in the formation of knowledge, as a process that allows for the generation of new conceptual possibilities. Pushing forward the relationship between knowledge and imagination, I argue that the requirement for justification expressed in classical epistemology can be found not only in communicable, codified modes of information transfer. Rather, it is in the directionality of knowledge that the justification of the tacit must be pursued, through the exploration of the poetic rationalisation of information that configures a generative potential – what knowledge makes possible.

Drawing on forms of knowledge appraisal centred on its outputs – in which metrics such as patents and process improvements are used as proxies for knowledge – I argue that knowledge can be understood as the foundation of these ranges of possibilities, or *epistemic horizons*, that reflect the conditions of existence for practice and discourse within a sociocultural environment. Based on this analysis, in the final section I propose that architectural knowledge can be appraised by its potential to objectify abstract space, exposing the ranges of possibility explored in the architectural sketches of Belgian architect Eduard van Steenbergen. I conclude that design can be understood as a method of manipulating spatial relations in a virtual materiality, embodying the networks of skill, knowledge and agency in the production of architecture.

The question of knowledge appraisal

Dating back to Plato, epistemology has generally regarded knowledge as 'justified true belief'.[2] For a person to know a proposition, the proposition itself must be true, the person must believe in its validity and the person's belief must be justified. The idea is deeply associated with the pursuit of truth, but it also proposes that in spite of being (and in order to be considered as) true, knowledge also needs to be justified as such. The implication is that knowledge is inherently linked to a methodological dimension – that is, knowledge needs to be accessible in one way or another. Disregarding, for the moment, the never-ending philosophical problems of truth, the justification side of knowledge may be a good starting point for analysis.

The necessity for knowledge to be justified is associated with the historical development of epistemology, located in the foundation of modern science, implying a concept of knowledge as a 'secured, methodically acquired and communicable insight'.[3] This correlation between knowledge and science is commonplace in modern thought, but despite their intimate relationship, it can be misleading to confuse the two terms. The uncritical acceptance of technoscience can foster a simplistic understanding that knowledge has an intrinsic 'epistemic character'; that is, that knowledge can only, or primarily be achieved through scientific means (mostly mistranslated as mathematical or quantitative methods), to the detriment of the arts and philosophy, for example – a notion known as 'scientism' and heavily criticised by Friedrich Hayek.[45] The assumption that knowledge can only be obtained through science is controversial. The practice of science is a situated endeavour and, as such, its outcomes are often permeated with biases that reproduce dominant or oppressive discourses in the guise of a neutral rationale, as in the case of standardised intelligence testing, which keeps on reproducing its eugenic origins even now.[6] Moreover, the question presents a fundamental paradox in the definition of knowledge itself. The belief that science is the only legitimate claimant to knowledge, based on science being the sole means of justifying true belief, would require treating science as the means to its own legitimation.

The confusion between science and knowledge has old roots that can be traced in the etymological history of the terms. The old meaning of science varies greatly from its contemporary use: from the Latin *scientia,* which literally meant 'knowledge', in the fourteenth and fifteenth centuries the term ceased to represent every knowledge, designating instead a particular 'branch or body of learning'[7]. The meaning of the word narrowed further, often appearing as a synonym for 'art' until the seventeenth century.[8] From this period on, the term 'science' began referring to skills more related to theoretical knowledge, designating the methods and observations that provided 'demonstrative proof in an argument'.[9] The continued development in this direction, Raymond Williams suggests, is deeply related to the distinction between 'experience and experiment' that

was made in the eighteenth century, establishing a specialisation in the understanding of science that excluded 'many other areas of knowledge and learning'.[10] In the nineteenth century, science began to be confused, once more, with multiple bodies of knowledge, in a movement 'where a particular and highly successful model of neutral methodical observer and external object of study became generalized, not only as science, but as *fact* and *truth* and *reason*'.[11] Science thus became both the justification and truth that supports knowledge and, as such, the entirety of its objective dimension. Once again, science and knowledge were conflated. But this time, rather being than represented by it, knowledge was limited by this particular interpretation of science, and other forms of knowing were disqualified.

While this confusion between science and knowledge seems to still survive,[12] a more contemporary definition of science, found in the Cambridge dictionary, suggests a more methodological relation: '(knowledge from) the careful study of the structure and behaviour of the physical world, especially by watching, measuring, and doing experiments, and the development of theories to describe the results of these activities.'[13] In turn, knowledge appears as the 'understanding of or information about a subject that you get by experience or study, either known by one person or by people generally', and 'the state of knowing about or being familiar with something'.[14] On the one hand, this description implies that knowledge can be obtained by the same means available to science, namely experience, which can be read in both the quotidian and laboratory meanings (more precisely divided into experience and experiment, mentioned above). On the other hand, it refers to information, which, in its dictionary description, appears as 'facts about a situation, person, event, etc.', implying a direct link to a concrete dimension.[15] In this line, the dictionary description of knowledge, albeit not explaining much in terms of the processes or the quality of knowledge, highlights its relationship with something external, to which the knower is related, indicating a directionality in knowledge. Knowing is knowing something. This directionality can provide a better distinction between knowledge and science, and some principles for their assessment. Justification, from this perspective, can be seen as the correlation between the something that is known and its existence, measured by its observability; science, in turn, can be seen as a validation model to assess how reliable knowledge (or a way of acquiring knowledge) is, in terms of its observation in reality.

Moreover, the link between knowledge and objective reality seems to be based on information, a relationship studied by the sociologist of science Harry Collins. Trying to clarify the distinction between tacit and explicit knowledge, Collins devises an overarching conceptual metaphor of knowledge as 'strings of information'.[16] These strings can be understood as sequences of organised information that allow it to be understood and, therefore, applied. In Collins's view, knowledge involves the transfer of 'the ability to accomplish new tasks', and can be interpreted as the utilitarian semiotic content of information, the part of information that humans can understand and apply.[17]

While Collins abstains from the appraisal of knowledge, limiting his analysis to the identification of knowledge's potential for explication, Daniele Fanelli tries to address the question from a similar interpretation of knowledge, but with a radically different approach. Echoing Collins's argumentation, where justification follows the premise that knowledge is the compression of information by the creation of 'patterns', Fanelli proposes the development of a mathematical formula to appraise knowledge.[18] In his equations he seeks to quantify knowledge, considering the level of change performed in information and the overall use of this information to qualify a particular explanation or theory.

Fanelli's attempt is significant, but presents problems. His description of the value of theoretical knowledge concludes with this statement: 'the value of a theory is inversely related to its complexity and directly related to the frequency of its use'.[19] It is a questionable claim. His formulation disregards the difference in subjects addressed by theories that are valued in relation to one another. Fanelli is aware of the question, and he tries to provide an answer: 'Given two theorems addressing different questions, in the more general case, the difference in knowledge yield will depend on the lengths of the respective proofs as well as the number of computations that each theorem allows to be spared.'[20] However, it seems as a weak argument that the length of the formula can be directly associated with the extent of the given explanation. These are not easily quantifiable variables – often short explanations are dependent on more lengthy knowledge, such as codes or mathematical principles, and gauging the extent of explanation some knowledge provides is a difficult endeavour. Fanelli's premise creates situations in which the evaluation of knowledge becomes purely speculative, which, conversely, undermines the enterprise of fitting the question in a mathematical equation. Another problem arises if one deals with knowledge that cannot be fully (or practically) translated into computations because the resulting explanation would be too long.[21] This form of knowledge would, in Fanelli's view, be the least valuable of all, simply because of its length, regardless of its contribution to society or its power to explain concrete reality.

Collins and Fanelli offer important contributions to the development of a method for the appraisal of knowledge, but they lack stronger a consideration of the social

properties of knowledge, in the sense that treating knowledge as a collection of information units or computations reduces knowledge to a simplistic numeric quantity that, by some other operation, provides explanation. This operation, for the authors, is performed by information. But by itself information is not knowledge; 'the mere provision of information holds no guarantee of knowledge, let alone of understanding', as Tim Ingold reminds us.[22] Relying heavily on information theory, authors like Collins and Fanelli blur the boundary between knowledge and information. Knowledge implies the rationalisation of information – thus it requires the capacity to associate, to extrapolate (particularly important for architectural knowledge), and to predict, which, in Fanelli's terms, is an ability to compare a given set of information with previously acquired information and come up with a probability of results.[23]

The poetic imperative of knowing

Fanelli's notion of prediction is still limited: it doesn't explain how information is compared to prior knowledge or the magnitude of this operation, much less the possibilities for extrapolation. In any case, from Fanelli's proposition of newly given and previously acquired information, it is possible to devise some conditions for the formation of knowledge. These conditions can be used to describe a crude, minimal standard process of information rationalisation to describe the acquisition of knowledge. They are:

a) The most basic form of meaningful information rationalisation imaginable is a simple correspondence between the new data and a previously existent categorical framework or, to use Collins's terms, 'patterns'.[24] When the case is a simple comparison, which seems to be Fanelli's general understanding of how knowledge comes to be, the patterns are previously established, and only then are they projected on the new context. The processing of information, in such a case, can be thought as an equation – it takes previously formed patterns and examines the new information through them, fitting the recognisable features of the new context into the slots of the given variables. The result is twofold: on the one hand, there is the association of new information with previously existing patterns; on the other, there is a by-product of unprocessed information. In other words, in this first model, any data that does not fit the existing categories is ignored – the process through which information is analysed is addressed only insofar as problems are solvable by the first set of patterns.

b) Another scenario takes place whenever the new set of information also changes the patterns itself, meaning that the new information is not only compared with the given patterns, but adds on to them in a process of adaptation. One example of adaptation would be that, after information is processed in accordance to simple correspondence, the remaining, problematic information which does not fit the existing categories is processed to create new categories. The result is simple: the creation of new patterns. Alternatively, information can be processed by reviewing formerly used patterns, in order to make them useful for addressing the missing analysis. In other words, the second model proposes a process of categorical shift in which already patterned information is organised in a different way: the knower's categorical database is not just expanded, but also changed.

c) Finally, a meaningful attempt at addressing how information can be rationalised into knowledge must take into account the possibility to extrapolate, which is so common in human cognition and can be referred to as the poetic. It can be thought as a process similar to adaptation, but implying a situation in which the new information operates on the patterns a fundamental shift. In this case, the new information is assessed and the patterns are actualised beyond what is necessary to explain the new data, generating new possibilities of association and affecting their underlying logics. In comparison with the previous operation, the new information is not only used to review the patterns previously formed, but to reconstruct (partially or fully) the logic of their formation, changing the very rationale behind the patterning process. In other words, it changes the rules of classification and categorisation behind the acquisition and organisation of information, effectively creating new modes of understanding.

The combination of these three processes describes a spectrum of information processing operations that can sufficiently explain most instances of ordinary learning. At one end of this spectrum is a direct and utilitarian operation, requiring little adaptation of established patterns. This mode could be called analytical, and it produces a way to navigate the world according to previously acquired knowledge but with little change to its underlying logic. An example of this is the process of learning of a new word in a familiar language. While it involves a simple case of placing the word within previously existing categories, such as noun, verb or adjective; the addition of a new word also implies a new way of representing a given situation, and it carries etymological and ordinary connections that associate its signifier with different categories, objects or actions. At the other end of the spectrum there is a mode of comprehension that effects a deeper change. In this operation, one incorporates new information and develops new insights from them, allowing for the assessment of previously acquired information through newly structured patterns that may improve or change the existing explanation. This mode might be called a developmental process, because it entails not only the acquisition of information, but a change in the pattern structure or, in other words, in

the methods of navigating the world. An example would be learning a new language, with its grammatical and semantic particularities that allow for a radical new way of representing the desired situation and the construction of meaning. A middle term between these two modes of apprehension probably describes the most common experience of learning and processing new information.

The poetic process, on this spectrum, plays a reflexive role that could explain the process of how new patterns are created: through the rejection of previous associations and hierarchies, it allows the development of a multiplicity of 'points of view', as described by Paul Feyerabend, as an operation where the possibility to associate different pieces of information is multiplied in an exponential growth of possibilities.[25] In this sense, this mode of apprehension relates to *poiesis*, the emergent process of coming into being of things that did not exist before, 'a process of creation' through which 'one becomes the other'.[26] By lifting limitations and suspending previously acquired patterns, and reducing the rigidity of the phenomena of the world, the poetic process raises the complexity of possible relations, and allows the thinker to scope different associations. It can be thought of as the capacity to play with information and categories and, in opposition to Fanelli's claims, to decompress information. The poetic process increases knowledge potential by crossing and merging patterns, contrasting different rationalities – followed by a process of rematching new patterns within reality, reduced and repositioned in their concrete context: 'grooming' patterns back to the directionality of knowledge.

The process could be seen as analogous to working of dreams. Current theories of the function of dreams propose that, during sleep, free from the dangerous reality of the physical world, the brain processes the information acquired when awake, not by fitting it neatly where it is best accounted for, but by purposefully creating new situations.[27] By venturing outside the reasonable, dreams test the limits of the possible. In this theory, dreams are irrational by design but, counterintuitively, represent a process of rationalisation.

Therefore, the workings of the poetic model may describe the leap from information to knowledge, explaining how new information is related to old, and how it proceeds to form an expansive understanding of the world. Knowledge formation thus requires abduction, the ability to proliferate and foresee. In other words, the imaginative side of knowledge acquisition is not simply a rationalisation of information towards a probable answer, but also the expansion towards possible configurations, creating a horizon of possibility.

Ranges of possibility

The overall picture of how to appraise architectural knowledge seems clearer, but still challenging. Knowledge and learning are somewhat clarified in terms of their conditions and operation, but remain difficult to measure. Therefore, another approach might be useful: to appraise knowledge in business, Paul Eisenberg suggests using metrics such as the number of patents, new models of products, services and the like – focusing on pragmatic outputs and avoiding the confusion between science, knowledge and information.[28] From these pragmatic outputs, he argues that it is possible to construct a picture of how information is being used, which in turn gives an outline of the knowledge involved. While limited in its potential to differentiate the parts with a properly epistemic character among the many aspects of production, Eisenberg's method presents a concrete (or at least pragmatic) way of appraising knowledge, with a clear advantage: it looks at knowledge from a situated position. It does not evaluate forms of knowledge by their scientific adaptability, but, instead, by their influence on real, complex environments.

Taking advantage of Eisenberg's method, it is possible to construct a model for the appraisal of knowledge in the framework of architectural research and practice. My proposition is that architectural knowledge can be recognised, qualified and valued by what it makes possible. This operation requires understanding knowledge by the principle that characterises the mind as 'a second-order or recursive structure' that is 'oriented toward the virtual rather than simply toward the real', as described by Merleau-Ponty.[29] That is, in this interpretation, knowledge is understood as the rationalisation of information that makes something possible – the combination and organisation of information through the reflexive movement of the imagination, in response to the perceived environment, which is directed towards the creation of a virtuality, a potential. Knowledge is thus not a thing to be possessed, or a substance embodied in bits, but a relation of significance that proposes a virtual development, in line with Bateson's information imperative of making a 'difference'.[30] This development can be an ideal fact, like a mathematical truth, or a physical, material object, like a chair. The shapes identified as objects, the movements made to perform an action, the association between phenomena and sensations; all these are informative of the world and constituent of its virtuality: what it might be. Knowledge, as such, is present in both the way the world is understood and acted upon.

Since my proposition is that it is possible to appraise (and understand) knowledge by the generative potential it can operate (knowledge's associated range of possibility), it accords with Collins's understanding of knowledge as always related to praxis, but with a fundamental difference:

it considers more than just the immediate consequence of knowledge and whether it is justifiable, but also its potential as a new realm of possibility. This difference can be better understood, perhaps, by using one of his examples: the baker and the bread-making machine.[31] Collins argues that the knowledge in the bread-baking machine is equivalent to that of the baker, because it yields the same result, bread. For Collins, therefore, the baker's knowledge is encapsulated in the machine and, as such, baker and bread-machine have the same knowledge. What Collins fails to account for is that the baker's knowledge, which allows him to make the same bread as the machine, because of its poetic potential, is much broader than that of his mechanical competitor. In theory, there could be machines that encompass all the possible breads that the baker can make, but still they would fail to compare to the baker because their knowledge is static. These machines would be limited to their own productions, to what figures in their technical repertoire, and so, the knowledge they possess as a collective will always be limited to that potential, equal to the sum of their individual products. Bakers, on the other hand, without needing new information, can cross-reference their knowledge and get a different result – for example, experimenting with croissant dough in the shape of a doughnut in the invention of the cronut.[32]

This is what Merleau-Ponty describes as a process of 'coherent deformation', a tentative disruption of available significations, distorted to reveal new potential.[33] The operation requires imagination, and it exemplifies the need to consider the poetic mode of apprehension as a parcel of knowing. The knowledge possessed by the baker, precisely because of its breadth and adjacencies, allows this form of multiplicity, and thus the range of his possibility is greater than that of the combined machines. It is worth mentioning that, indeed, this capacity seems to be challenged in the case of the newly developed generative artificial intelligence, which can cross-reference knowledge. The AI's process is a statistical operation that, for the moment, stems from human prompts. Whether it can actually replicate the baker's *poiesis* remains to be seen, but in any case, the AI would represent a fundamental shift from Collins's collection of bread-making machines.

The focus on the relationship between knowledge and the potential it brings forth also helps avoid a problem of justification pointed out by Aileen Oeberst and her team in a paper reassessing what knowledge is.[34] The authors argue that in classical epistemological studies, knowledge is conceived as something that is localised in individuals, and, therefore, knowledge must be justified at the individual level. The individualist nature of this concept of knowledge, especially in regards to its justification, creates problems, for example, 'when considering mass collaboration and education' as 'the requirement for individual justification might not be met for each person involved'. In areas where collaboration is commonplace, for example, in the realm of science, where 'knowledge resulting from the project can hardly be attributed to only one person', the problem becomes evident.[35]

If the justification of knowledge can be found in the context of its social application, knowledge doesn't need to be incorporated in one individual to be operative. As long as it increases the potential of a particular phenomenon, knowledge can be considered to be real. Networks of agents with different sets of information or partial knowledge can therefore be seen, in cooperation, as the holders of a larger body of knowledge. If the organisation of these agents allows for a new potential, whether a new concept, a new product or a new way of doing something, it can be considered, as constituting new knowledge. This collective knowledge can be recognised in practices that are institutionalised under a profession or discipline, like architecture, and it is carried forth within the relationship between its practitioners.

Finally, in this proposition, justification can be realised through indirect examinations, related to the social use of knowledge and its implications. Knowledge can be justified by an assessment of its effect, possible employment and conditions of use. This way of appraising knowledge does not fixate the idea of truth. In this notion, truth is only important in relation to the proposed potential of knowledge: how much and under which circumstances knowledge affords possibilities. Therefore, my approach does not demand that knowledge be scientific. Science appears as a method, rather than a premise: science is understood not as a measure of the validity of knowledge, but of its generality, its scope and reproducibility under varying circumstances. Alternatively, this mode of appraisal makes it possible to accept artistic methods as knowledge, and can be used to explore what different ways of thinking and making make possible. In Feyerabend's words, it does not propose 'only one correct point of view'.[36]

The appraisal of architectural knowledge

Following the mode of knowledge appraisal by its generative potential, it is possible to analyse the methods, techniques and processes used in architectural design, addressing how they develop possibilities within the field and, consequently, expose the particular knowledge of architecture. In other words, it is possible to appraise the knowledge of architecture by accessing what design does.

In this direction, Peter Schmid, writing about professional know-how, argues that an architectural tool – a sketch, for example – allows architects to engage a particular spatial configuration:

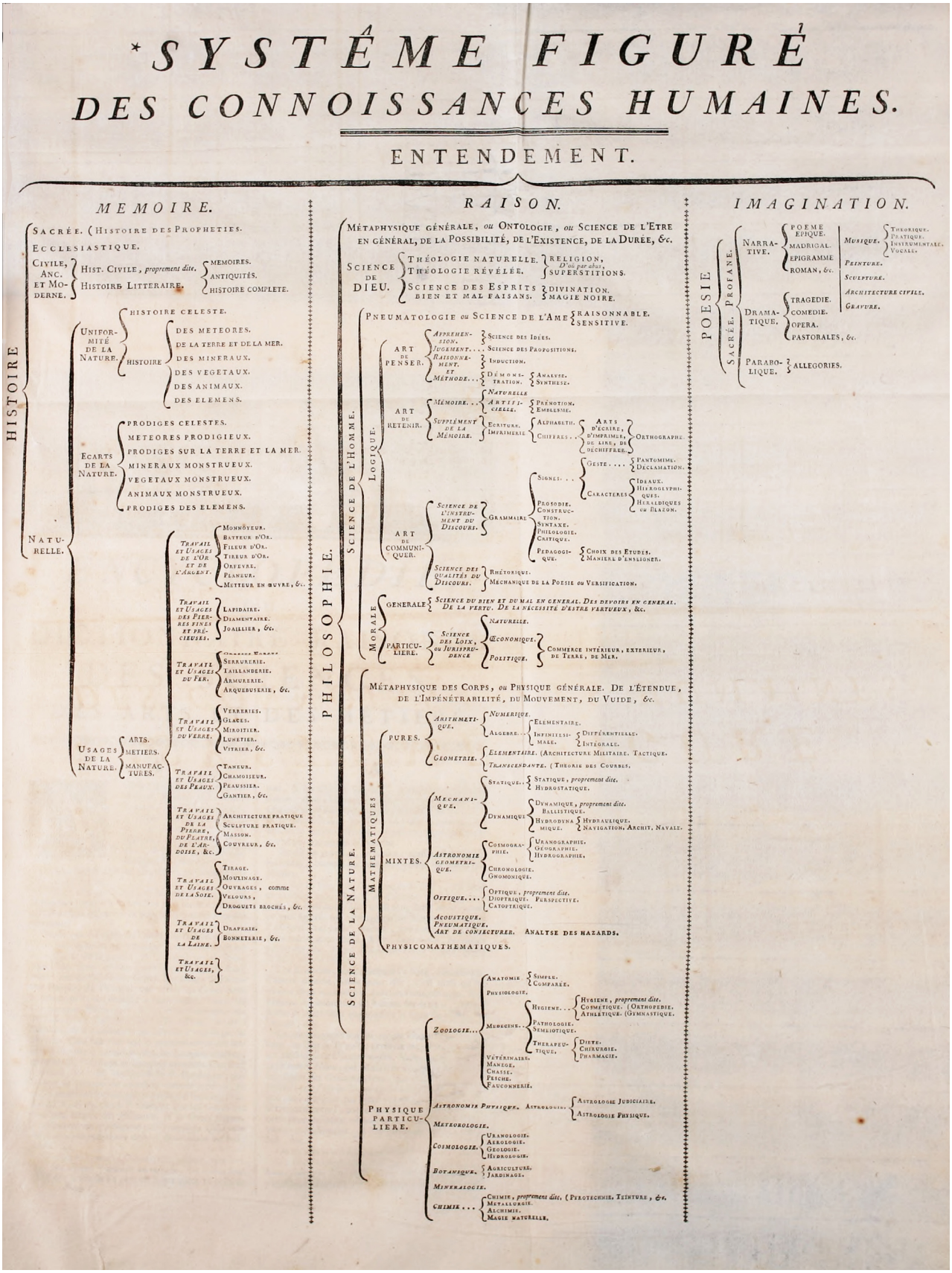


Fig. 1: The separation of knowledge, or 'understanding' (*entendement*) in Diderot's *Encyclopédie*.

> Regardless of the external form, whether analogue or digital, the ability to sketch spatial situations is a fundamental requirement for creative work in architecture. The processes that take place during the development of spatial ideas in drawings are procedures which, in the case of practicing architects, mature into schematic experiences, or, in other words, into a "procedure know-how" that is difficult for outsiders to understand or comprehend.[37]

This is possible because, from the mind to paper, ideas become less ephemeral and more stable. They no longer depend on the immediate focus of the architect to exist, which frees their makers to address other questions, and add complexity to the project. Questions of dimensions, boundaries, flows and interaction between material elements and environments can be assessed by drawing a floor plan, for example, aiding architects as they imagine possible solutions. In other words, by being sketched, ideas acquire a degree of reality. When they are externalised from the mind, it becomes possible to objectively engage with them. They are, as it were, objectified.

The reiterative nature of this process is well known in architectural design studios, and can be easily seen in archival collections.[38] In this sense, to appraise the knowledge of architectural design, it is worth analysing how sketching and drawing enable a range of possibility. Held at the archives of the *Vlaams Architectuurinstituut,* the collection of Belgian architect Eduard van Steenbergen (1889–1952) provides a telling example: vast and comprehensive, it includes a great number of sketches, giving a good idea of the role of sketching and drawing throughout the design process.

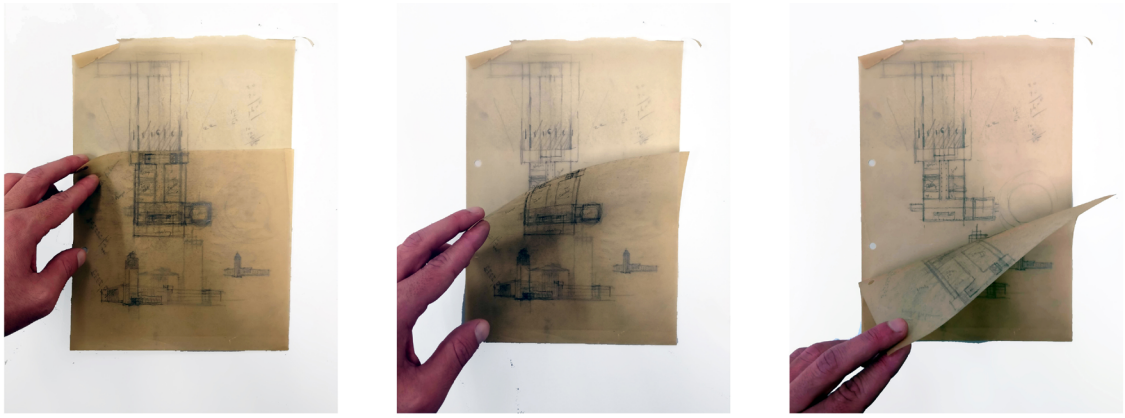
Steenbergen seems to be the kind of person that was always drawing. For the Districthuis in Deurne he sketched profusely in all kinds of formats, in keeping with the stereotypical architect drawing on a napkin. Plans, perspectives and technical details of the Districthuis are drawn on a high-grammage, green-tinted paper carrying the logo of the Excelsior Hotel in Antwerp, on the back of a flyer inviting people to a *Gymkhana* in Berchem, and even on a page ripped from an appointment diary, marking 1 January. [39] Partially, this abundance can be attributed to overdesign, the practice of designing and overseeing all or most elements of architectural production, common among architects of the art nouveau movement such as Antoni Gaudí and Victor Horta. The scope of Steenbergen's work included the detailed design of ornaments, furnishings and furniture. However, most of his sketches are repetitive and very similar, suggesting that the architect used them primarily as a way to explore different spatial organisations and architectural compositions. Through repetition, Steenbergen slowly built up difference, working iteratively and incrementally.

The materiality of the drawing material itself contributed to this practice of reiterative transformation. Benefitting from the transparency of tracing paper, for example, van Steenbergen would fold drawings over each other, trying out subtle changes and variations in the floorplan. [Fig. 2] In other sketches, he progressed through ideas alternating between pencil and pen, as if solidifying the solutions that pleased his judgement, and demonstrating awareness of the potentials afforded by the not-quite-permanent quality of sketches, and the differences in contrast between graphite and ink. [Fig. 3] Particularly interesting in this practice is the increasing level of detail added to the drawing, while the scale remains the same. Progressively, one sees the appearance of windows, furniture, fixtures and even the silhouettes of people, enhancing the realism of the sketch. Besides improving the representation of the project's proportions, these increases in detail show Steenbergen's tentative exploration of particular drawing scales (1:50, 1:100 etc.), working to the limits of resolution and making the most of his material.

Alongside the increasing detail there is a shift in scale. This strategy allowed the architect to work simultaneously on the part and the whole, and is mostly used to address details, as in the Districthuis's tower, while keeping in sight the detail's context. [Fig. 4] It can be seen as a way of imparting to the details the sort of autonomous quality that Eduard Ford describes: of being something valuable and distinguishable in itself without losing the connection to the unity of the building.[40]

Finally, Steenbergen's sketches also display the use of different modes of drawing in tandem. [Fig. 5] Plans, perspectives and sections are often sketched together on the same sheet of paper, providing an overview of the project and reflecting how changes to one particular aspect (for example, the spatial organisation) impacts the whole. In this way, Steenbergen could test different things simultaneously, moving across structural, spatial and aesthetic considerations and imparting diverse sets of knowledge in the design process.

It is possible to see from these few examples how sketching allows the architect to maintain multiple concerns of the design's virtual reality in the background while finding his way in the problem as a whole – or the other way around, allowing for particular solutions to be developed directly in relation to the overall design. Moving between diverse scales and modes of representation, the iterative development of the sketch produces a 'tentative outline of a form that is … being deliberately distorted or deformed to reveal some previously unrealized potential'.[41] This process can be understood as an instance of abduction, that



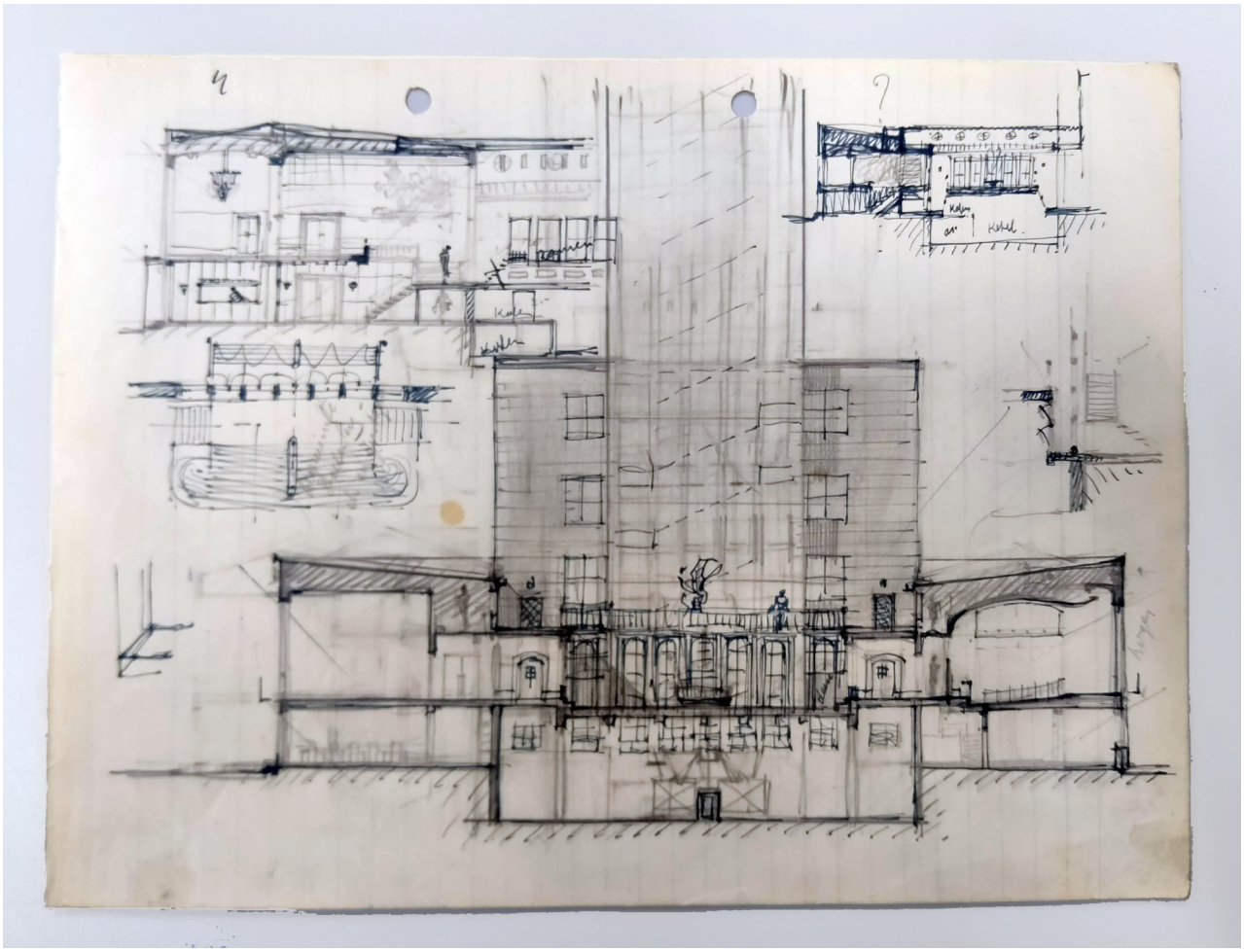


Fig. 2: Eduard van Steenbergen, overlapping sketches. Source: VAi.

Fig. 3: Eduard van Steenbergen, graphite and ink sketch. Source: VAi.

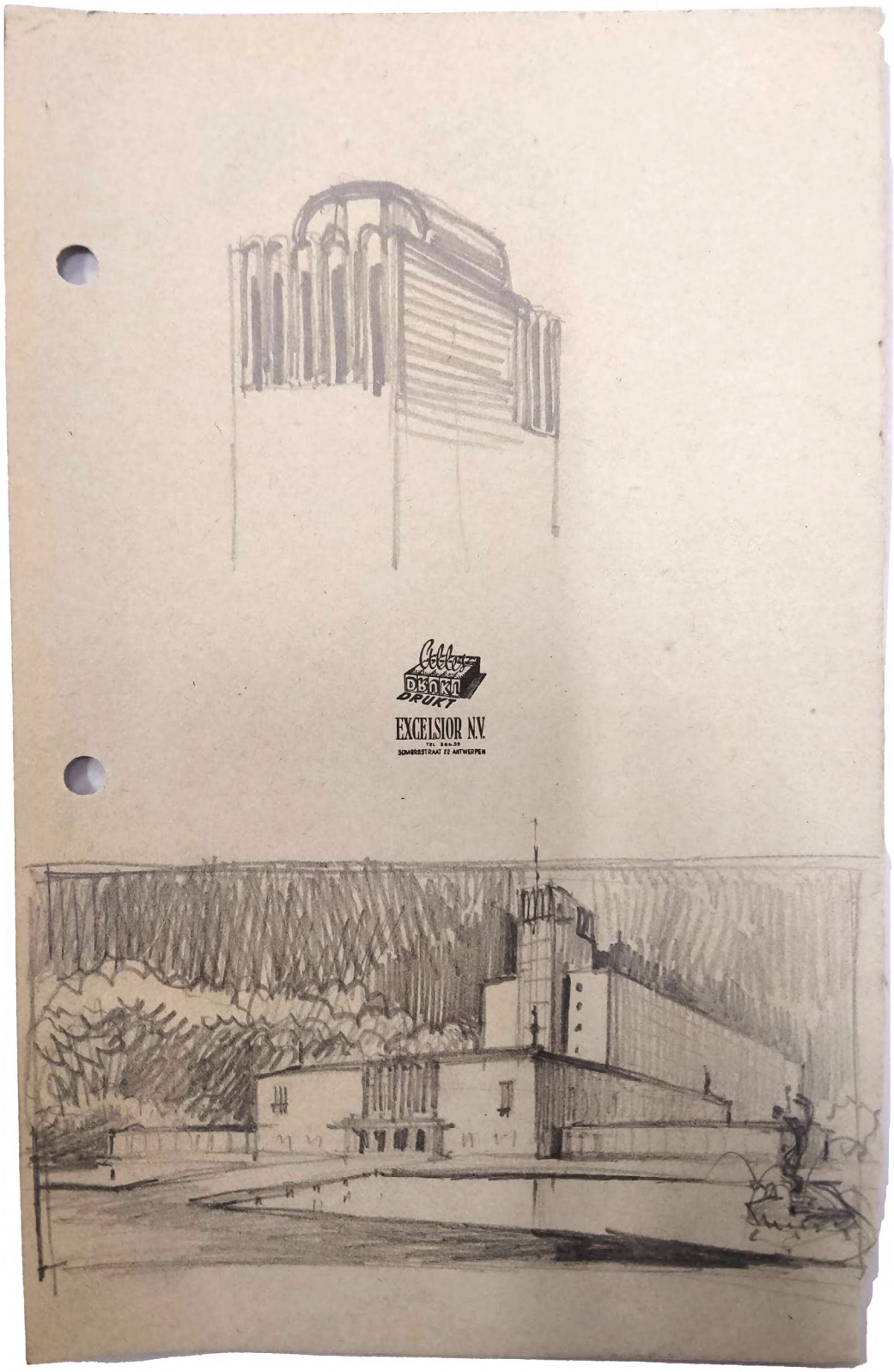


Fig. 4: Eduard van Steenbergen, detail and building perspectives depicting the Districthuis Deurne. Source: VAi.

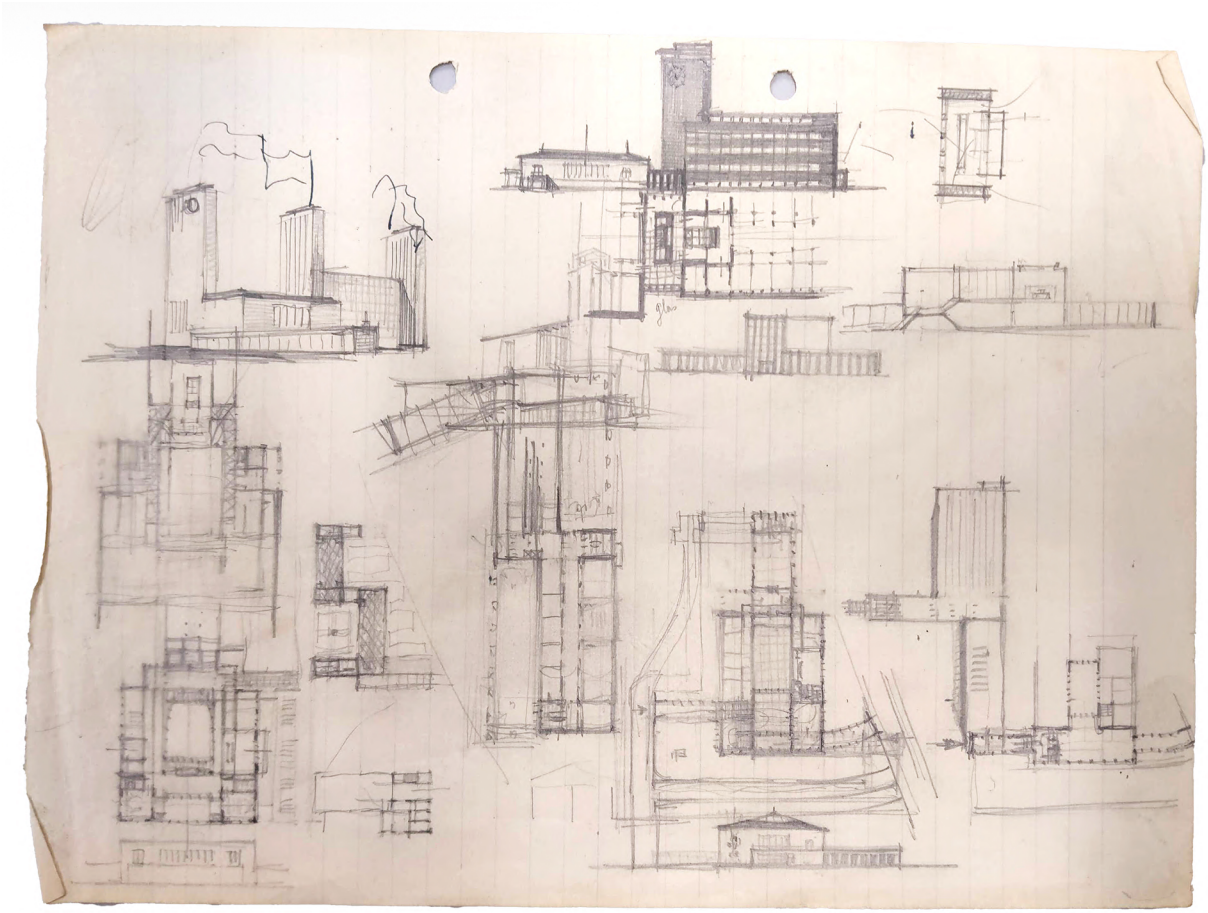


Fig. 5: Eduard van Steenbergen, sketches of the Districthuis Deurne. Source: VAi.

is, an operation where architects reach towards a solution through incremental leaps of inference – or as in the poetic process of understanding described above, as a form of imaginative proliferation from which solutions are teased into emergence. In any case, the process of sketching can be seen as a form of rationalising information, establishing knowledge by the clarification of a range of possibilities. From the engagement with this virtual, latent reality objectified in the sketch, designers can enact processes that simultaneously gather and rationalise information. In other words, they establish an epistemic horizon and, therefore, knowledge.

> The design drawing offers a freedom to the architect to engage in a more radical level of invention. By providing a safe way of simulating and testing of new solutions – without the expense of building at full-size to find out how it might actually work – the drawing provides a realm of exploration and experiment that would otherwise be unavailable.[42]

Sketching, evidently, is not the only tool architects have at their disposal. From the development of perspectival drawings in the Renaissance, through the plaster casts of the Beaux Arts model of education, to modelling (both physically and digitally), the history of the architecture profession is populated by many practices that can be analysed under similar terms.[43] They allow architects to explore, in a tentative way, many aspects of the spatial-material configuration of the built environment, manipulating the dimensions, materials and elements in the form and substance of buildings. These connections, or 'leaps of associations made between materially engaged things and abstract ideas of architectural order and space', in the words of Christopher Bardt, establish the common ground within which disparate concerns can be addressed in a single problem, as Donald Schön would phrase it.[44] They bring 'architecture into a symbiosis of language-like, symbolic and as physical experience' that is tacit in nature.[45] While not problematic for designers themselves, this tacit character makes the task of appraising architectural knowledge difficult.

Somewhat counterintuitively, however, these associations can be seen when drawings did not suffice – where the range of possibility of architectural knowledge has to be addressed in some other way. Besides enabling the creative practice of sketching, architectural drawings carry knowledge across disciplinary boundaries, operating as communication devices and helping designers to realise ideas across diverse communities of practice, in contact with, for example, engineers, contractors and other specialists. Not seldom, however, technical drawings alone prove insufficient to convey the whole complexity of design between different professionals. Particularly, there are two instances in Steenbergen's collection in which it is possible to see how the architect dealt with such limitations with the help of writing.

In the first case, the architect was designing a gravestone for the Van Den Berghe de Decker couple.[46] In addition to the more traditional drawings usual in architecture, in the corner there is a set of instructions for the craftspeople – quite remarkable because, unlike the common project descriptions in architectural designs, they don't refer only to the materials, but also to the actual processes of making – giving instructions, for example, of how the stones should be polished and their corners rounded. [Fig. 6] Translated to English, the message reads:

> Upper plate and columns in blue limestone, best quality. The edge of the plate is polished, as well as the top with edges and inscription. The background is to be deeply sandblasted and then very finely and evenly pointed. The columns are smoothly polished. Everything must be assembled firmly.
> The component is to be covered with glazed plaques.
> All on a reinforced concrete foundation.
> Additionally, a concrete vault for two coffins.
> The price should include delivery and execution, as well as delivery time and payment terms. Samples of plaques and the type of sandblasting to be seen at the architect's office.
> 5 October
> Ed. Van Steenbergen[47]

Less grim in character, the second instance is a wardrobe design for the Kolonielaan house.[48] In this drawing, besides assigning a specific place for each item of clothing – somewhat mimicking the overdesign approach criticised by Adolf Loos in *Poor Little Rich Man* – Steenbergen once again adds instructions for its construction on the paper sheet.[49] Organised in bullet points, these instructions focus primarily on the materials to be employed, providing insight into the architect's particular knowledge, for example, assigning the use of a zinc tray specifically for snowshoes.

These examples are significant because, occurring at the interface between design and production, they show the boundaries of the knowledge performed by different tools, revealing the limits of their employment. These documents serve as witnesses to the range of possibilities practiced by architects and the knowledge of their particular methods. From Steenbergen's accompanying writings, one can grasp some of the knowledge the architect had about materials and their specific productions processes. Conversely, it is also possible to recognise in them the stonemasons' and woodworkers' knowledge, represented by their capacity to interpret the drawing and text, but most importantly, by inferring what remained unwritten. Understanding the limitations of technical drawings and

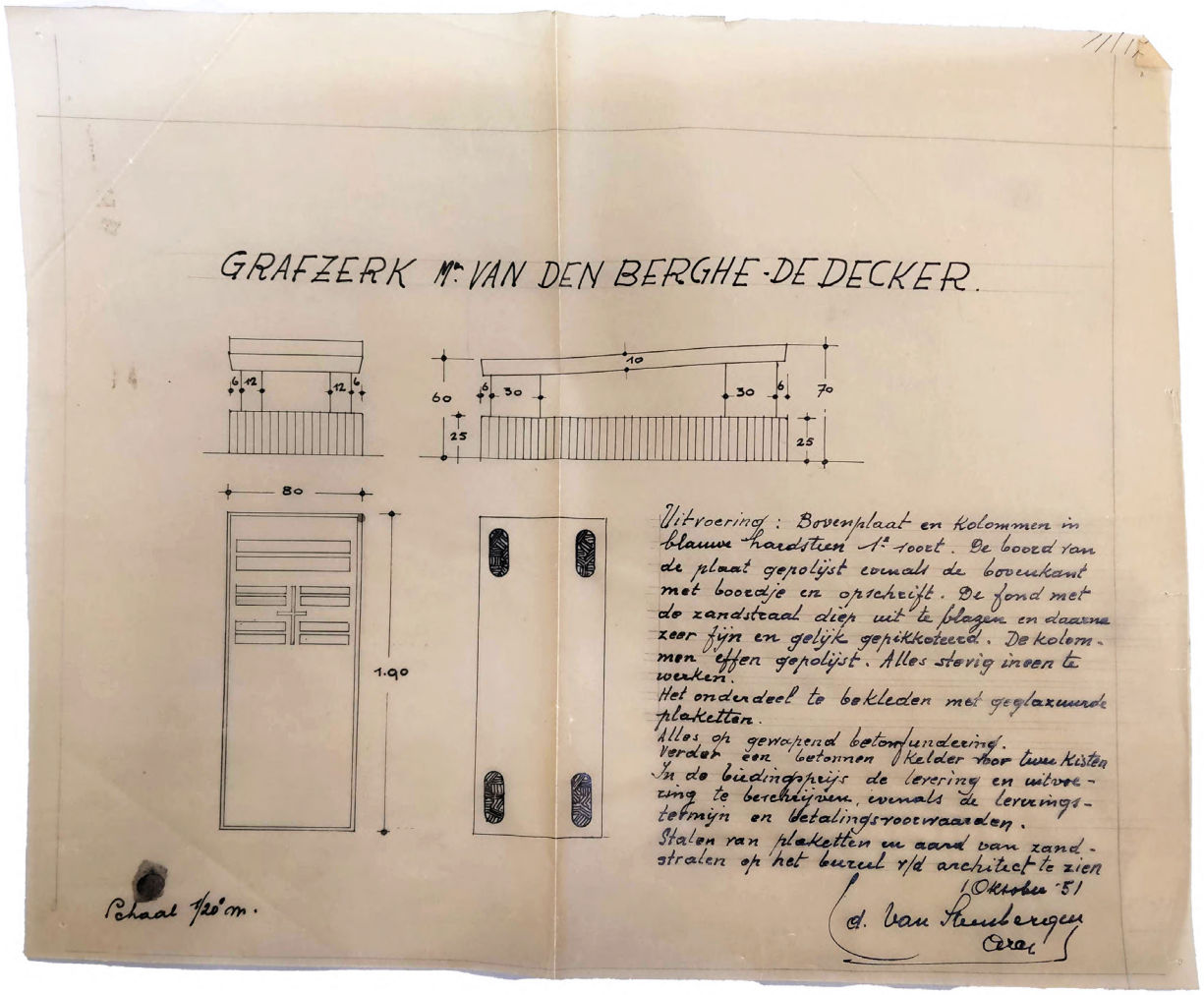


Fig. 6: Eduard van Steenbergen, gravestone design with instructions. Source: VAi.

representations with regard to the exact material qualities and processes of the depicted objects, it is possible to envision how much of the gap between idea and reality is addressed in the workshop or at the construction site by craftspeople. Both by what they represent and what is left silent, these drawings mark the flow of information across communities of practice, showcasing how a productive arrangement – such as the network of professionals mobilised for the design and construction of a building – produces and performs knowledge. Coalesced in the technical drawings, the information of architectural solutions is transmitted to contractors who associate it with their skills, inferring the particular operations that allow for an idea to become a material reality. Effectively providing a concrete solution to an abstract, spatial challenge, from sketch to site, the design and construction process form a system through which problems and possibilities can be known, developed and built.

The method of knowledge appraisal by the assessment of its generative potential shows that architectural tools afford a particular kind of practice and skill. They are mostly related to the conception of spaces and their objective form and substance, but also function as communication devices in the disciplinary networks of the construction site. These tools operate a particular knowledge, establishing a specific range of possibility: they help architects close the gap between various spatial possibilities and the material conditions of architectural production. In other words, these tools allow architects to perform their practice in the objective world, and characterise it as a form of knowledge.

Conclusion

The conflation of science and knowledge creates a tendency to overlook the complexities inherent in knowledge production and validation, perpetuating a narrow form of knowledge appraisal. The consequences can be seen in the work of Harry Collins and Daniele Fanelli: from Collins's metaphor of knowledge as strings of information to Fanelli's mathematical formulas, information-based modes of knowledge appraisal overlook the poetic nature of knowledge and ultimately fail to provide a method that encompasses tacit knowledge.

The focus on the generative potential of knowledge allows for a form of knowledge appraisal that does not need a mental disposition, a belief, and its connection to an unattainable truth to be recognised. Instead, it latches knowledge in practice, in the crossover between real and virtual. By considering knowledge in terms of its potential to generate new phenomena or practices, this form of knowledge appraisal avoids a fixation on truth and scientific validation. It opens avenues for understanding diverse forms of knowledge across cultures and communities of practice, and acknowledges the context-dependent nature of knowledge.

This model of appraisal allows a direct way to recognise, in architecture, the networks of knowledge in the production of design, and clarify the relationship between architects and their tools. Through this lens, design processes can be understood simultaneously as tools that allow architects to deal with the specific qualities of their craft, making them explicit and ready to hand, and as epistemic artefacts embodying the translation of technical, theoretical and aesthetic domains into spatial and constructive languages. In short, the tools of architectural design express a kind of knowledge with a broad horizon, as it is directly related to a poetic, imaginative pursuit of simulated possibilities, but also refers to the capacity to materialise these ideas.

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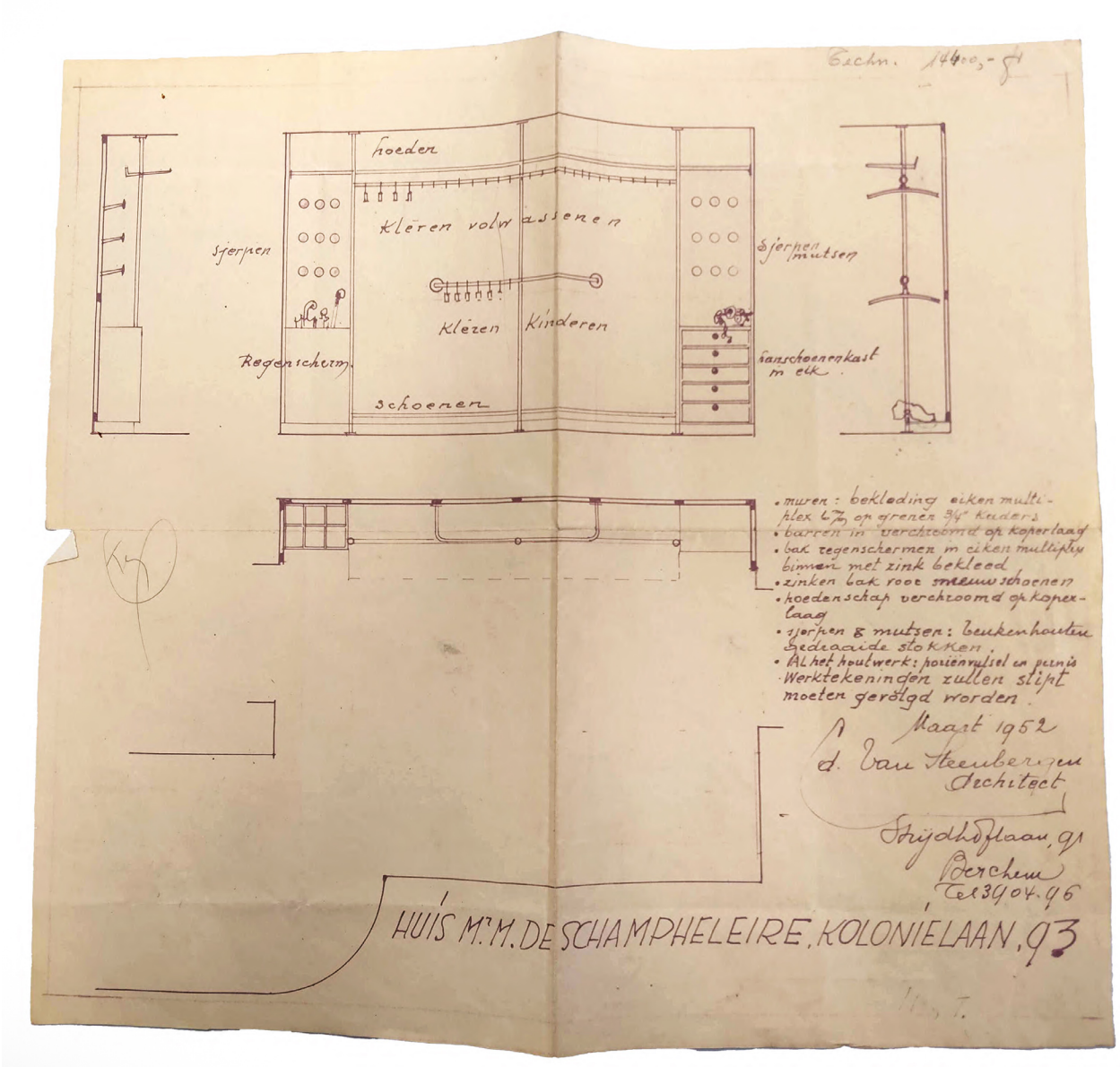

Fig. 7: Eduard van Steenbergen, design of a wardrobe with instructions. Source: VAi.

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Biography

Dr. Eric Crevels is a Dutch-Brazilian architect, urban planner and craftsman whose work focuses on material cultures and the intersection of craft and architecture, investigating the built environment from the perspective of labour, skill and technique. His research bridges architectural design and construction studies with anthropology, sociology, and philosophy, creating new connections between theory and practice. Dr. Crevels is committed to exploring the ways craftsmanship can inform contemporary architectural design, production, research and history, by developing new approaches, methods, and tools. His work aims to expand the understanding of how labour, craftsmanship, and architectural creation intersect, offering fresh perspectives on the design and production of the built environment.